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Results and Conclusions of

Locomotive Slipping Tests*

By
T. V. Buckwalter†
and
O. J. Horger‡

Tests on three roads, using high-speed motion photography, show graphic record of forced build-up of unbalanced rotating forces until the main drivers leave the rails

The demands for higher speed in railroad transportation in both freight and passenger service, particularly the latter, has raised new problems in connection with the maximum permissible speeds for steam locomotives.

Passenger schedule speeds previous to the advent of the streamliners were satisfactorily negotiated at diameter speeds. Train schedules have been shortened in the last few years, requiring locomotive operation at speeds much higher than diameter speeds. These faster schedules have involved locomotive speeds approaching and in some cases exceeding the top safe operating speeds for conventional steam locomotives from the standpoint of the danger of causing rail damage. Concurrent with the high operating speeds has been the demand for more powerful locomotives, particularly in the upper speed range, and these two requirements have accentuated the dynamic forces on the rail resulting principally from counterbalancing conditions.

This subject of rail damage was brought forcibly to our attention with the introduction in service of the New Haven 4-6-4 passenger locomotives in 1937. It was thought in some quarters that rail damage developing on this road might be due to some extent to the introduction of roller bearings on drivers which was new at that time on this road. After considerable discussion among ourselves, W. C. Sanders, manager railroad division, suggested to the New Haven that a definite slipping test be made on greased track to produce high rotative speed of the drivers so that the test could be viewed over a selected piece of track by railroad men and other interested observers.

Such slipping tests were made on the New Haven and later on the New York Central and Santa Fe.

New Haven Tests

Slipping tests were made with two 4-6-4 locomotives, one having plain-bearing driving axles (I4 class) and the other locomotive having roller-bearing drivers (I5 class). The first series of tests on both locomotives did not produce rail damage which was explained by insufficient slipping speed of the plain-bearing engine and not leaving the throttle open for sufficient time beyond the greased section on the roller-bearing locomotive, even though the maximum slipping speed was calculated to be 121 m. p. h. Several later tests were made, however, where rail damage was sufficient to require rail replacement. In such tests the train speed was about 55 m. p. h. and maximum slipping speed about 114 m. p. h. As a result of these tests the overbalance on the main pair of wheels of this class of locomotive was reduced from about 200 to 100 lb., and we understand that such

Table I — Slipping Tests Made on C. B. & Q. Locomotives

Kind of locomotive tested			Driving-wheel diameter, in.	Test speed, m.p.h.		Length of greased section, ft.	Dynamic augment, main driver*	
Number	Type	Class		Train speed	Max. slip speed		Diameter speed, lb.	Max. slip speed, lb.
3012	S-4	4-6-4	78	56	98	230	14,111	27,053
				66	108	230	21,600	41,400
3001	S-4-A	4-6-4	78	47	88	230		
				67	98	230	14,111	23,193
				70	100	230	21,600	35,500
4003	S-4-A	4-6-4	78	72	112	300		
				78	123	300	4,596	12,377
				81	128	504	8,480	22,800
6314	M-4-A	2-10-4	64	51	80	504	11,315	17,680
				53	80	230	15,430	24,100
5604	O-5	4-8-4	74	67	93	230		
				74	102	230	6,000	11,850
				80	104	230	12,930	25,570
5623	O-5-A	4-8-4	74	78	111	300	5,520	13,330
				80	115	300	11,500	27,700

*The first value given is calculated using conventional overbalance in counterbalance plane and second value is actual dynamic augment in plane of rail; the difference being the error in using the conventional overbalance weight and differences in planes. See Table III and text for explanation.

* Part I of the abstract of a paper presented before the New York Railroad Club, February 17, 1939, in connection with motion pictures.
† Vice president, Timken Roller Bearing Company, Canton, Ohio.
‡ Research engineer, Timken Roller Bearing Company.

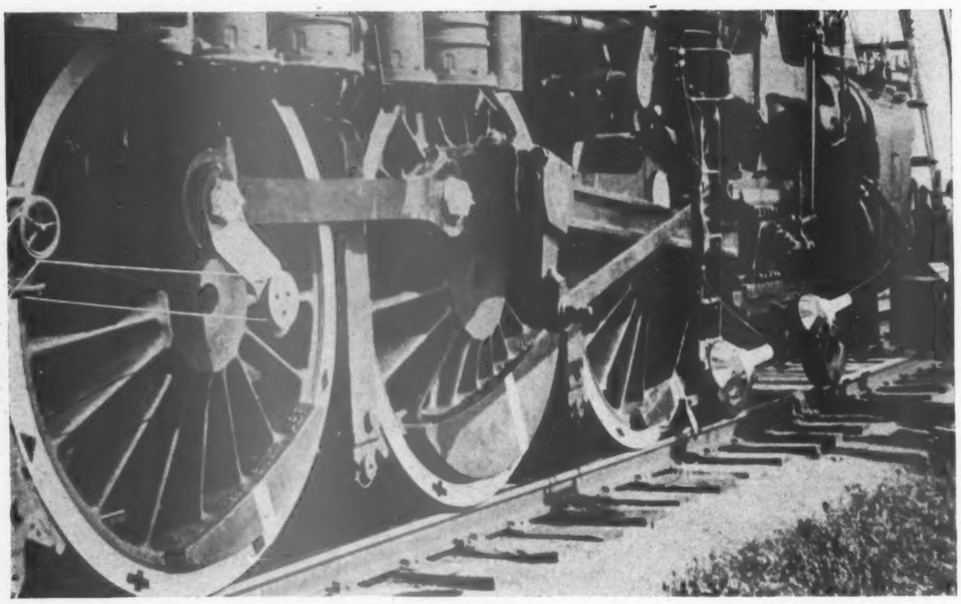


Fig. 1—Running gear of one of the C. B. & Q. 4-6-4 type locomotives, showing the markings on the wheels, speed indicator drive, and photographic lighting equipment. The camera is shown in Fig. 10. This locomotive has conventional rods and crossheads

modification has corrected their difficulties with rail damage.

New York Central Tests

The New York Central introduced the J3A, 4-6-4, Hudson type locomotive in 1937, and slipping tests were made on the main line track to determine the speed at which rail damage would be produced with an overbalance of 100 lb. in the main wheel. These tests were made in April, 1938, involving four slipping tests at train speeds of 61 to 82 m. p. h. and with maximum slipping speeds from 123 to 164 m. p. h. The three locomotive tests up to 135 m. p. h. left some question as to whether the wheels lifted off the rail because of difficulty in following the locomotive with the cameras and the clarity of the pictures, but no rail damage developed. In the test at 164 m. p. h. the drivers definitely left the rail but no track damage developed of sufficient importance to necessitate removal of rail.

The New York Central slipping speeds were considerably higher than the New Haven and indicated that the lightweight reciprocating parts, reduced dynamic augment, lower unbalanced reciprocating weights, and heavy rail had a distinctly favorable modifying influence on high-speed locomotive operation. No modification was made in the balancing of these locomotives as a result of these tests.

Santa Fe Tests

The Santa Fe railroad made high-speed slipping tests on one of its new 4-8-4 locomotives at Albuquerque, N. M., in June, 1938. This is a much heavier locomotive than those previously tested, having a weight of reciprocating parts in proportion to its power. Slipping tests made on yard track resulted in considerable rail damage at about 97 m. p. h., but it should be mentioned that this track constituted worn rail removed from main-line service and the ballast did not represent main line conditions. These locomotives are equipped with roller bearings throughout and are used in hauling the fast Santa Fe trains over the mountain district of 1,200 miles between La Junta, Colo., and Los Angeles, Calif. Further tests were being made with this class of locomotive to determine track and bridge stresses but we are not familiar with any final changes that were made relative to counterbalancing.

Conclusions From Above Tests

It was apparent from these tests that the photographic method used was inadequate for detailed analysis of the action of the main driving wheels on the rail. The slipping tests made on the above three roads were photographed with 16 mm. cameras mounted on tripods and located on the ground. Even though telephoto lenses were used considerable difficulty was experienced in holding the driver-rail contact in the field of view while following the locomotive with the camera as it passed the observer.

These moving pictures, notwithstanding the technical difficulties of photography, developed interesting informa-

Table II — Data for Six C. B. & Q. Locomotives Used in Slipping Test

Locomotive class	S-4	S-4-A	S-4-A	O-5	O-5-A	M-4-A
Road number	3012	3001	4003	5604	5623	6314
Type of locomotive	4-6-4	4-6-4	4-6-4	4-8-4	4-8-4	2-10-4
Builder	C. B. & Q., 1935	Baldwin, 1930	Baldwin, 1930	Baldwin, 1930	C. B. & Q., 1938	Baldwin, 1927
Rebuilt	Plain-bearing drivers and reciprocating parts	Timken driver bearings, equipped 1938	Timken rods and reciprocating parts and driver bearings, equipped 1938	Plain-bearing drivers and reciprocating parts	Timken reciprocating parts and driver bearings, when built	Timken driver bearings, equipped 1938
Cylinder size, in.	25 x 28	25 x 28	25 x 28	28 x 30	28 x 30	28 x 32
Boiler pressure, lb. per sq in.	250	250	250	250	250	250
Driver diameter, in.	78	78	78	74	74	64
Tractive force, lb.	47,700	47,700	47,700	67,500	67,500	83,300
Weight on drivers, lb.	207,730	212,650	209,310	274,000	275,500	338,400
Weights of reciprocating parts, lb. (per side):						
Main rod	429	429	249	502	317	379
Crosshead, etc.	440	440	258	1,028	384	1,150
Crosshead shoes	352	352	114	402	141	391
Union link	32	32	26	32	28	32
Piston, etc.	856	856	379	516	508	501
Total	2,109	2,109	1,026	2,480	1,378	2,453

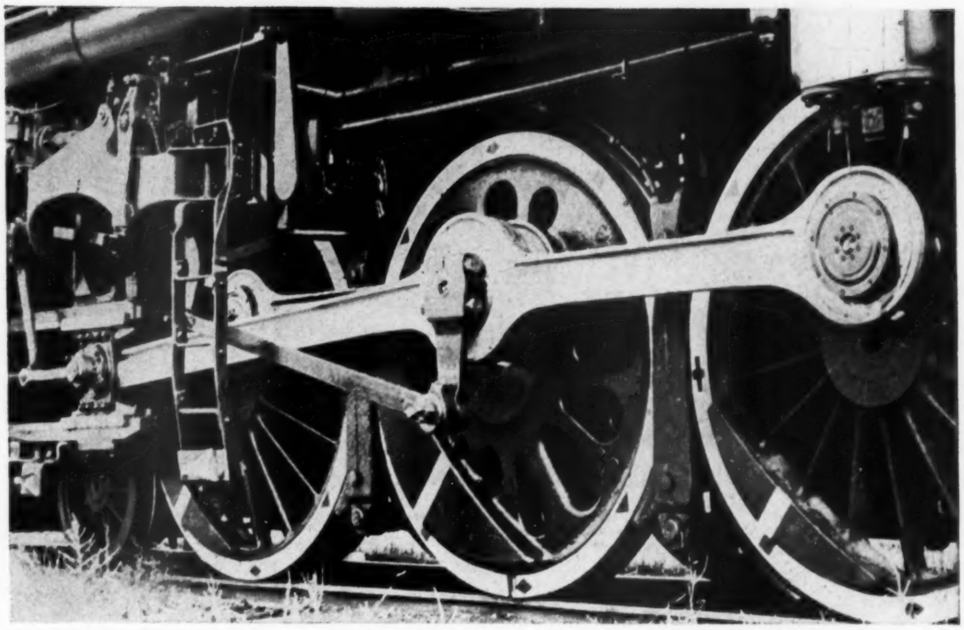


Fig. 2—Another one of the Burlington 4-6-4 type locomotives which has been equipped with roller bearings on the driving axles, lightweight reciprocating parts and roller bearing rods

Table III — Counterbalance Record on Six C. B. & Q. Locomotives Used In Slipping Tests

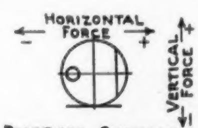


Diagram Showing Force Direction

Locomotive class	S-4	S-4-A	S-4-A	O-5	O-5-A	M-4-A	M-4-A
Road number	3012	3001	4003	5604	5623	6314	Not tested
Type of locomotive	4-6-4	4-6-4	4-6-4	4-8-4	4-8-4	2-10-4	2-10-4
Front Driver:							
Static balance, lb.	+245	+245	+103	+243	+ 95	+172	+72
Crossbalance* (plane of rail)							
Horizontal component, lb.	+219	+219	+ 68	+229	+ 78	+166	+62
Vertical component, lb.	+ 26	+ 26	+ 34	+ 14	+ 16	+ 6	+10
Resultant, lb. and angle	221 at 6 deg. 46 min.	221 at 6 deg. 46 min.	76 at 26 deg. 34 min.	229 at 3 deg. 30 min.	80 at 11 deg. 36 min.	166 at 2 deg. 1 min.	63 at 9 deg 10 min.
Front Intermediate Driver:							
Static balance, lb.	....	....	....	....	....	+172	+72
Crossbalance* (plane of rail)							
Horizontal component, lb.	....	....	....	....	....	+137	+33
Vertical component, lb.	....	....	....	....	....	+ 35	+39
Resultant, lb. and angle	....	....	....	....	....	141 at 14 deg. 20 min.	51 at 49 deg. 46 min.
Main Driver Crossbalance:							
A.A.R. method, lb.	+315**	+315**	+103	+125	+115	+175	+51
Same with correction on back end of main rod—per method of Henderson (plane of rail)							
Horizontal component, lb.	+478	+478	+188	+266	+236	+298	+75
Vertical component, lb.	— 47	— 47	— 21	— 35	— 30	— 35	— 3
Resultant, lb. and angle	481 at 5 deg. 37 min.	481 at 5 deg. 37 min.	189 at 6 deg. 22 min.	268 at 7 deg. 30 min.	238 at 7 deg. 15 min.	301 at 6 deg. 42 min.	75 at 2 deg. 26 min.
Back Intermediate Driver:							
Static balance, lb.	....	....	....	+353	+115	+221	+72
Crossbalance* (plane of rail)							
Horizontal component, lb.	....	....	....	+271	+ 41	+192	+36
Vertical component, lb.	....	....	....	+ 82	+ 74	+ 28	+36
Resultant, lb. and angle	....	....	....	283 at 16 deg. 49 min.	87 at 61 deg. 0 min.	194 at 8 deg. 18 min.	51 at 45 deg. 0 min.
Back Driver:							
Static balance, lb.	+245	+245	+103	+243	+ 95	+172	+72
Crossbalance* (plane of rail)							
Horizontal component, lb.	+217	+217	+ 5	+225	+ 77	+161	+56
Vertical component, lb.	+ 28	+ 28	+ 98	+ 19	+ 19	+ 11	+16
Resultant, lb. and angle	219 at 7 deg. 21 min.	219 at 7 deg. 21 min.	98 at 87 deg. 5 min.	225 at 4 deg. 42 min.	79 at 13 deg. 52 min.	161 at 3 deg. 55 min.	58 at 16 deg. 26 min.

*All main wheels cross counterbalance and other than main statically balanced—weights in pounds.
**2/3 of eccentric crank weight is used here whereas ½ is used on all other values given.

tion which proved of value to the respective roads. The pictures showed that the main pair of driving wheels was leaving the rail and in addition had a see-saw action across the track. In some of these slipping tests, the crank pin was in the up and others in the down position with respect to the rail when the wheel was off the track. Such lifting of the wheel from the rail could not be explained by conventional methods of analysis where the inertia forces of the counterbalance were considered. That is to say, that the driving wheel was calculated to begin to leave the rail when the speed was sufficient to develop an inertia from the overbalance equal to the weight on the wheel. In these tests, however, the wheel left the rail much earlier than would be anticipated from such calculations.

At that time it was our belief that this lifting of the main wheels was due to forced vibrations, but this could not be confirmed because of insufficient test data. These forced vibrations were believed to have developed principally from the overbalance to cause the unsprung mass of the driving axle assembly to vibrate and lift off of the track structure which acted as an elastic foundation. This explanation seemed reasonable in view of being able to demonstrate such action by laboratory models and mathematical analysis. Introduction of forced vibrations was new in that driver speeds of sufficient value had not

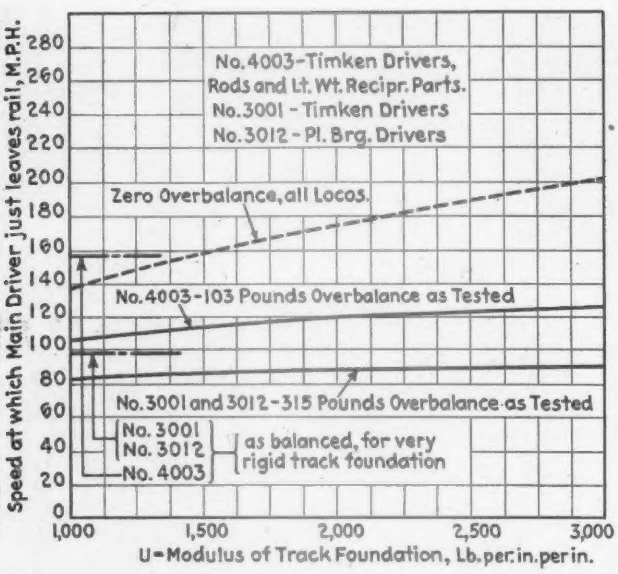


Fig. 3—Comparison of calculated speeds at which the main driver leaves the rail

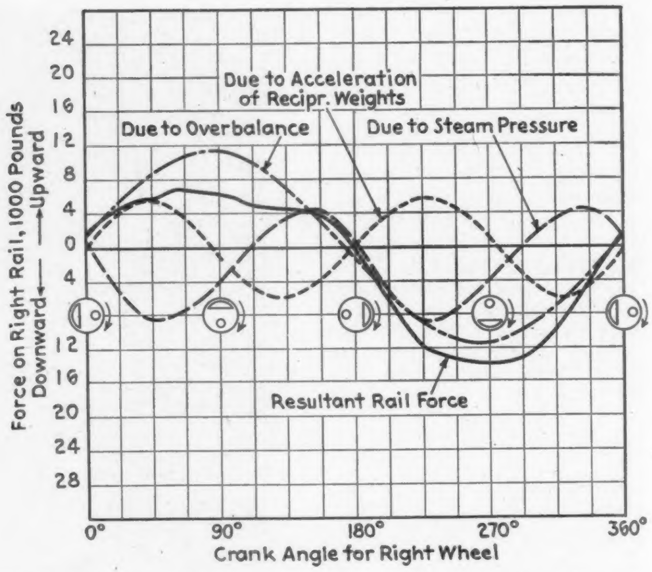


Fig. 6—Dynamic rail force under main drivers, locomotive 4003 with Timken drivers, rods and light weight reciprocating parts

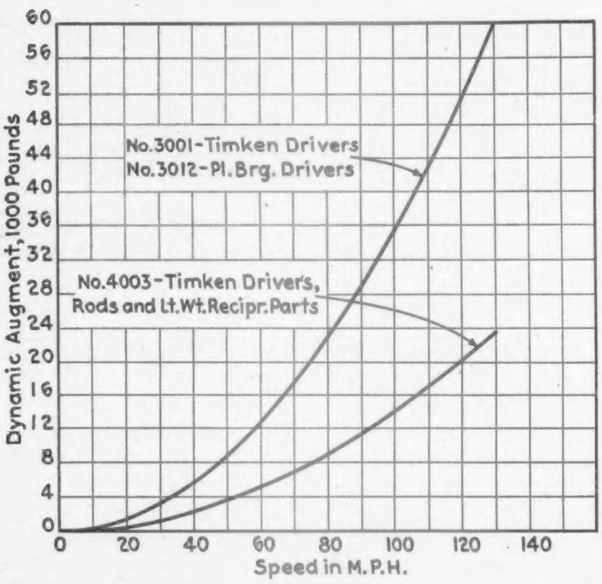


Fig. 4—Comparison of dynamic augment on 4-6-4 main drivers

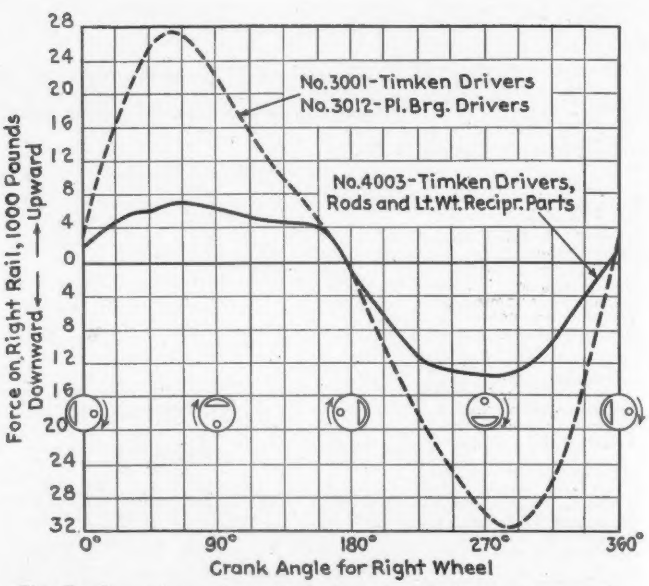


Fig. 7—Comparison of resultant dynamic rail force at 90 m.p.h.

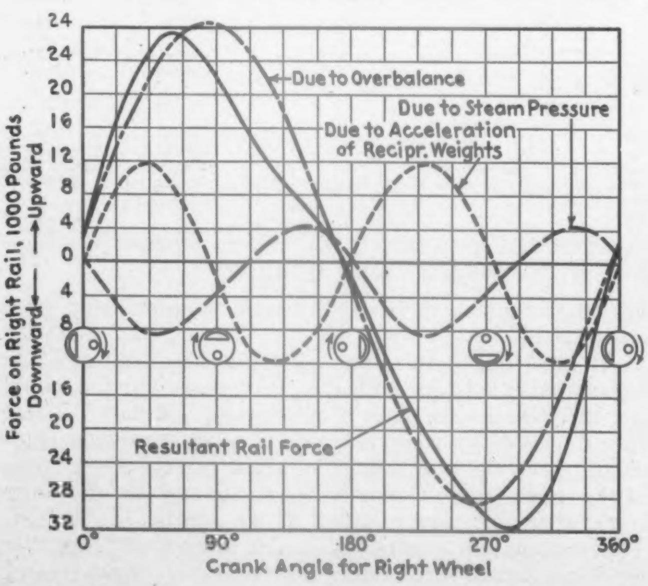


Fig. 5—Dynamic rail force, main drivers, locomotives 3001 and 3012 at 90 m.p.h.

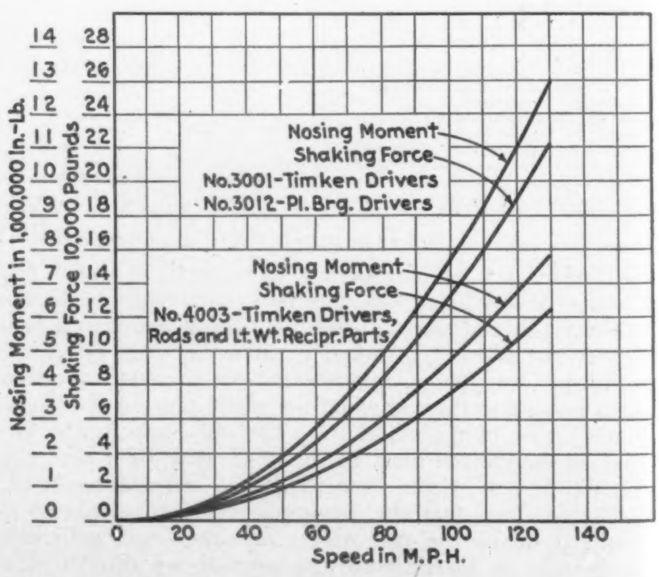


Fig. 8—Comparison of nosing moment and shaking forces (fore and aft)

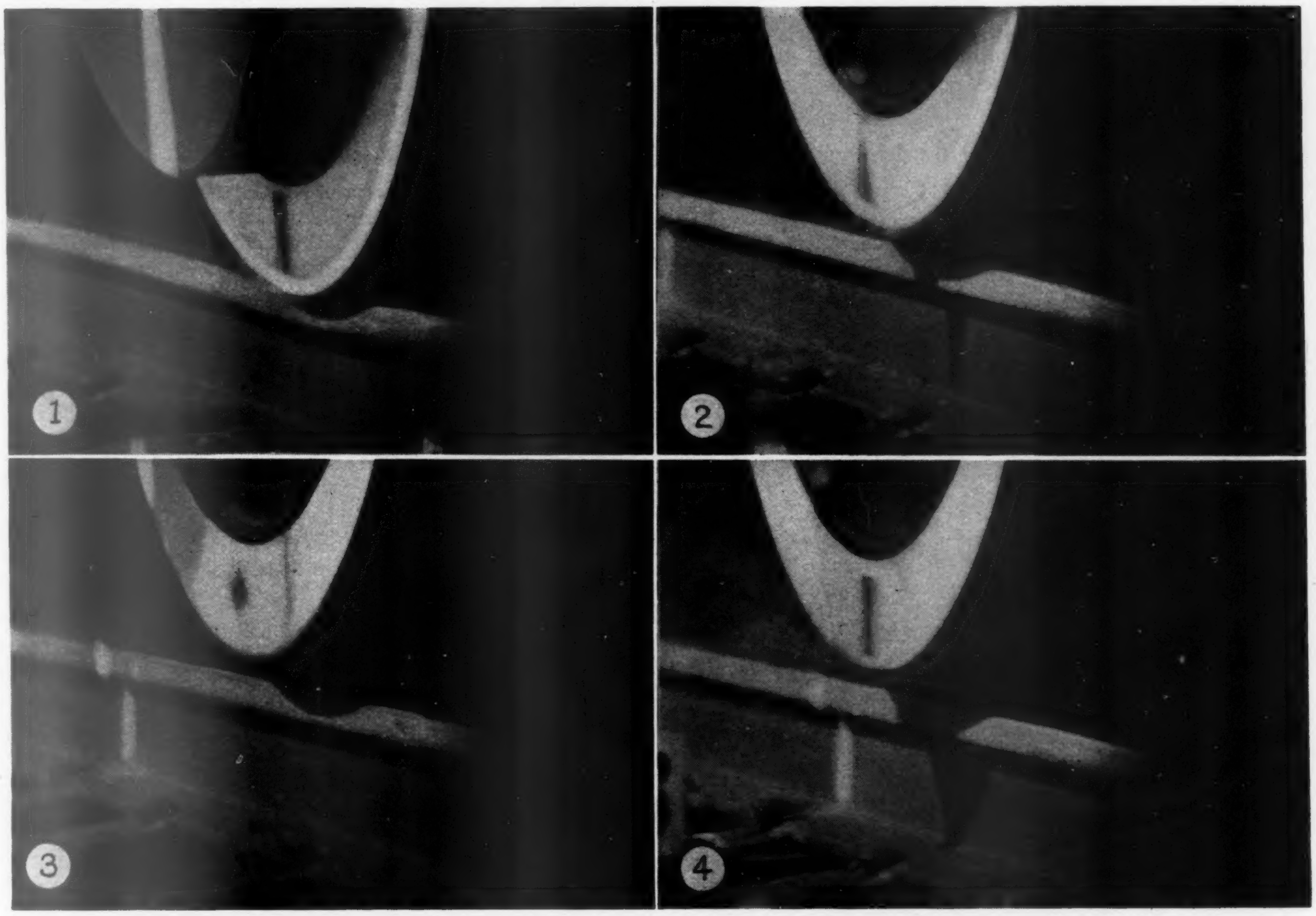


Fig. 9—Enlargements made from 16-mm. movie film taken at 400 frames per second (25 times normal speed)

Burlington 4-6-4 type locomotive No. 3012 equipped with plain bearing driving axles and having 2,109 lb. weight of reciprocating parts per side with 315 lb. overbalance. The white vertical line on the counterbalance is diametrically opposite the main crankpin and does not indicate the center of gravity of the balance. In the above pictures the position of the balance is given with reference to the vertical line to the rail and the white line. Picture No. 1 shows the counterbalance down and the crankpin up; No. 2, counterbalance 90 deg. from vertical; No. 3, counterbalance 45 deg. from top vertical, and No. 4, crankpin down and counterbalance on top vertical

Table IV — Weight Per Axle, in Lb., on Six C. B. & Q. Locomotives Used in Slipping Test

Class	S-4	S-4-A	S-4-A	O-5	O-5-A	M-4-A
Road number	3012	3001	4003	5604	5623	6314
Type of locomotive	4-6-4	4-6-4	4-6-4	4-8-4	4-8-4	2-10-4
Front:						
Sprung	53,600	53,600	53,250	54,740	53,985	51,623
Unsprung	15,400	16,900	16,740	14,100	15,414	13,780
Total	69,000	70,500	69,990	68,840	69,399	65,404
Front intermediate:						
Sprung	....	....	....	....	....	50,364
Unsprung	....	....	....	....	....	15,370
Total	....	....	....	....	....	65,734
Main:						
Sprung	47,800	47,800	47,550	44,477	43,862	45,575
Unsprung	21,980	23,680	21,640	23,550	23,954	23,980
Total	69,780	71,480	69,190	68,027	67,816	69,555
Back intermediate:						
Sprung	....	....	....	52,869	52,138	53,323
Unsprung	....	....	....	15,510	16,784	16,450
Total	....	....	....	68,379	68,922	69,773
Back:						
Sprung	53,600	53,600	53,400	54,724	53,968	53,778
Unsprung	15,350	16,850	16,730	14,120	15,418	13,675
Total	68,950	70,450	70,130	68,844	69,386	67,453

been so generally experienced in operation in the past.

With this background of experience on these earlier slipping tests more extensive tests were planned on the Burlington which will now be discussed.

Burlington Slipping Tests

The Burlington requested our co-operation in determining the speeds at which rail damage may occur with several classes of road locomotives so that a safe road speed could be established. H. H. Urback, mechanical assistant to the executive vice-president, placed the technical direction of the picture study in our hands. The program involved the testing of six locomotives, as follows: three 4-6-4 passenger locomotives, two 4-8-4 passenger and freight locomotives, one 2-10-4 freight locomotive.

A record of the tests made is shown in Table I while Table II gives the physical characteristics of the locomotives and the weight of the reciprocating parts. The counterbalance statement is shown in Table III. The sprung and unsprung weights on driving axles are indicated in Table IV.

Location of Tests

The test track selected was a straight section for 5½ miles and was located on the main line from Chicago

to Omaha, Neb., between Plano, Ill., and Bristol, about 10 miles west of Aurora. The rail was 100 lb. RA rail laid on chat (lead ore) ballast. The test section was located on a fill varying from about 6 to 12 ft. deep.

Preparation for Test

Station number plates from No 0 to 50 were located on the ends of ties on about 12 ft. spacing on both the left and rights sides of the track for a distance of 616 ft. This was done so that the moving picture showing the action of the wheel on the rail could be identified with the location of any track damage. After the first locomotive test, it was found necessary to extend the length of the marked section about 300 ft. inasmuch as some track damage occurred beyond the 616 ft. length.

Fig. 10—Camera equipment on platform

The heads of both rails were greased with a rail flange graphite grease starting at station number 0 and extending for about seven rail lengths or 231 ft., which adjoined station 19. This length of greased section was increased in several tests to 300 ft. and 504 ft. as indicated in Table I.

Deflection gages were located between each tie from stations 31 to 34 to indicate maximum rail deflection. Additional gages were located on each tie between stations 44 and 45 to indicate rail and tie deflection, and such measurements were recorded by a moving picture camera. It developed that these gages were not located sufficient distance from the greased section to be in a region where the wheels did the most lifting from the rail.

The speed of the train was determined from gages located in the dynamometer car and locomotive cab. The slipping speed of the driving wheels was obtained electrically by means of a Weston generator drive connected to the rear driving wheels.

An indicating lever device was located on the side of each locomotive to show throttle operation. Its operation was in the field of view of the camera and a pictorial record of throttle operation with reference to location on test track was recorded in the moving pictures. An L-shaped lever was attached to the lower steps and the throttle is open when the lower leg of the lever is in the up position and closed with the leg down.

All driving-wheel tires were painted white and distinguishing black marks applied at 45 deg. intervals around the tires. A white line was painted on the counterbalance diametrically opposite the crank pin. The end of the crank pin was also painted white. This marking provided a reliably accurate means of observing the movement of the wheels on the rail.

Camera Equipment

The outstanding difference on the Burlington tests as distinguished from the three previous tests was in the selection and mounting of the camera equipment and taking pictures from both sides of the locomotive so that the wheel action on both sides of the locomotive could be correlated. In these tests it was decided to mount the cameras on folding platforms attached to the locomotive just ahead of the cylinders and about one foot above the rail. The camera equipment was furnished through the courtesy of the Eastman Kodak Company and consisted of two 100-frame per second motor-driven cameras, one being located on each side of the locomotive. In addition a third camera operating at ultra high speed of 400 frames per second was mounted on the right side. Normal picture speed is 16 frames per second so that the action of the wheels is produced in slow motion in the ratio of 6 to 1 and 25 to 1, thereby permitting a detailed study of driver movement with respect to the rails.

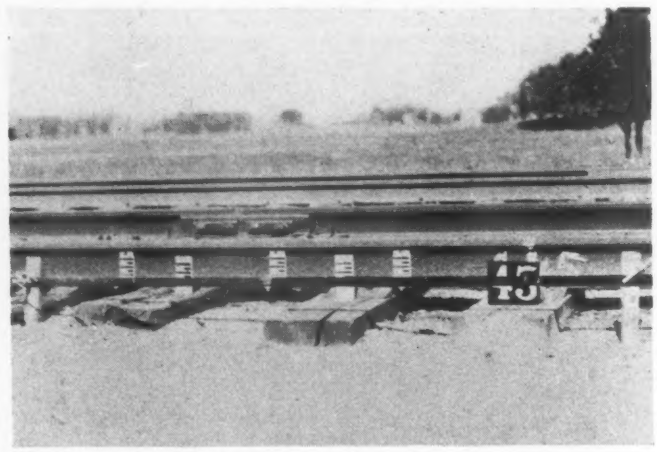


Fig. 11—Rail and tie deflection gages

Consist of Test Train

A total of five or six steel cars were used on all tests, consisting of one baggage, one dynamometer, and three to four passenger coach cars.

Test Procedure

The test train approached the greased section at a uniform speed as given in Table I. The throttle was left open beyond the end of the greased section for sufficient time to bring the slipping speed up to near the desired value which occurred in many tests at about station 70, or about 800 ft. beyond the beginning of the greased section. It is essential that the throttle be left open long enough for vibrations to build up. Vibrations dampen out at a fast rate after closing the throttle.

Modulus of Track Foundation

Determination of the value of modulus of elasticity of the track support was made over a length of track where the driving wheels lifted off the rail. This modulus was computed from measurements made at 47 tie locations using a loaded truck. Two different truck weights were used where the wheel loads were 5,150 lb. and 17,400

(*Continued on page 104*)

Serviceability of

Heavy-Duty Piston Rods

By H. G. Miller* and L. E. Grant†

Heat-treated carbon-steel rods show up well in competition with alloy-steel rods in extensive tests

EARLY in 1930 the Chicago, Milwaukee, St. Paul & Pacific took delivery of the first of 14 new high-speed, Class F6, 4-6-4 type locomotives, for heavy passenger-train service. Seven months later a piston rod on one of these engines failed by breaking at the crosshead fit and this was but the first of many similar failures. At one time more than 30 cracked and broken piston rods had been collected at the test department for inspection and analysis. It was soon obvious that something would have to be done about piston rods if these locomotives were to be kept in successful operation. A rather comprehensive test was planned, provisions being made to obtain records of mileage and other pertinent information for each piston rod.

Various kinds of steel were tried to see if one could be found that would give satisfactory service. Changes in the design and size of the rods were also made in an effort to improve the performance. The information that was developed during a period of about six years of such testing is interesting and it is believed that an account of it may be of some value to other railroad men. Piston-rod failures are a common difficulty and, if one can judge from the number of letters published in *Railway Mechanical Engineer,* piston rods are a live topic for discussion in many locomotive shops and roundhouses.

Stress in Piston Rods

The crossheads used on the engines referred to are the Laird-type, shown in Fig. 1. The center of gravity of the crosshead is 5.6 in. above the center line of the piston rod and this produces an unbalanced load on the rod. The assembled crosshead now in use weighs approximately 572 lb. This is more than the original crosshears weighed, but on account of some failures it was later found necessary to strengthen these castings and the weight was thereby increased somewhat. The calculated direct stress on the piston rod due to thrust was only 5,529 lb. per sq. in. It does not appear that such a low load, even after allowing for the weakening effect of tool marks and irregularities in the fit, should develop a stress in excess of the fatigue limit of ordinary steel. Probably with a conventional alligator-type crosshead with a balanced load this would be true and failures would not have been so numerous nor have developed in so short a time. However, in addition to the direct stress there are several other sources of stress, some of uncertain magnitude, which must be taken into account. One of the most uncertain of these is the tensile stress produced when the rod is drawn into the crosshead by the key. The intensity of this stress depends upon the accuracy of the machining. This factor of uncertainty cannot be eliminated in any event, but in the present case it appears not to have been the principal cause of failure. Rods fitted at the plant of the locomotive builder, as well as rods fitted at various shops on the Milwaukee failed. The effect of accuracy in the fit is, therefore, assumed to be only one of several rather than the principal source of stress causing early failure.

* Engineer of Tests, Chicago, Milwaukee, St. Paul & Pacific, Milwaukee, Wis.

† Metallurgical and welding engineer, Chicago, Milwaukee, St. Paul & Pacific.

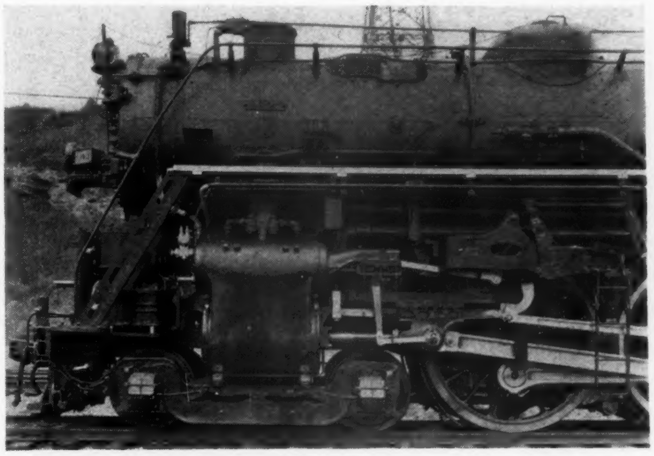


Fig. 1—Milwaukee 4-6-4 locomotive equipped with Laird-type crossheads

The crosshead is so heavy that it produces a bending stress of considerable magnitude in the rod. This becomes a maximum when the piston is at the back end of the cylinder and is not a negligible stress. The bending stress produced by the weight of the crosshead, plus inertia loading developed by the whip of the crosshead each time it changed direction of travel, was so great that all cracks started on the top of the rod. Fig. 2 shows diagrammatically the location of the origin of the fractures. The centrifugal stress increases as the guides and crosshead shoes wear, becoming a maximum when the clearance between shoe and guide reaches the permissible limit. A compressive stress is also produced in the rod by the crosshead when the piston key is driven home. This is in addition to the tensile loading mentioned above. It is possible to calculate this load theoretically but practically such a calculation has little value. The smoothness of the surfaces as well as the accuracy of the fit affects both this stress and the tensile stress. F. Williams, Canadian National, has recommended grinding piston rods to produce the best possible surface and fit and thus reduce this stress to a minimum as a means of reducing failures. Others do not consider this necessary and argue that it does not in fact produce any better situation than can be obtained by good machining. The piston rods under discussion in this article were not ground but a good smooth job of turning was done.

In addition to the stresses considered so far, there is the load due to column action from the axial steam loading. Taking normal values for this and all the other

known sources of loading it has been calculated that at a speed of 80 miles an hour there is a possible stress of 22,400 lb. per sq. in. in one of these piston rods 5¼ in. in diameter. At least half of this load is due to inertia forces from the unbalanced loading. A load of 22,400 lb. per sq. in. is approximately half of the fatigue strength of the plain carbon steel that was used. It is, therefore, quite apparent that the actual loads were much higher than the maximum calculated.

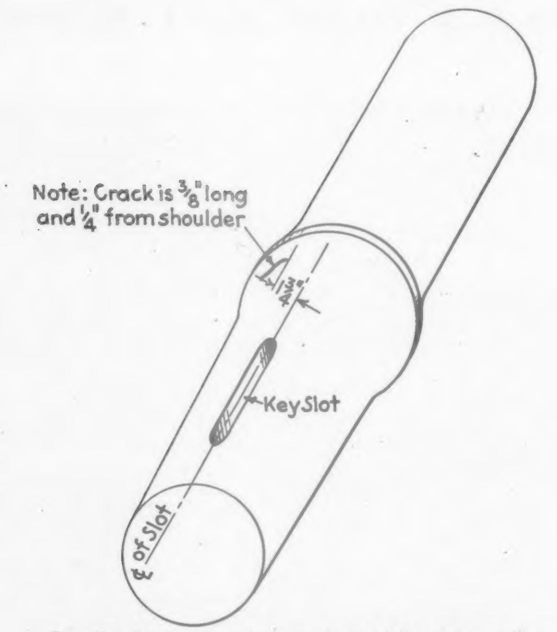


Fig. 2—Origin of typical crack in right piston rod

Even rods with much higher fatigue strength also failed. Much of the high stress is believed to be due to the use of a key in fastening the piston rod in the crosshead. The authors have for a long time believed that the key type of fastening for piston rods is an archaic device not well adapted for the purpose. Perhaps one should not criticise without having something better to offer but it is felt very strongly that a better fastening device can and should be found.

Originally the key was the indirect cause of many piston-rod failures even with the alligator-type crosshead. Cutting the slot in the rod frequently was done very crudely. A rough edge on the slot, or tool marks in the slot itself, acted as stress-raisers and caused the rod to break either at the end or sometimes in the middle of the slot. When this condition was remedied by better machine work, fractures began just back of the collar on the rod. It seems quite clear that in many cases the collar was drawn up against the front of the crosshead before the key had been driven in completely. Driving it further set up a heavy stress between the collar and the slot. Service stresses, combined with those already existing from driving the key, developed cracks which quickly spread across the entire section. If the collar did not strike, then the rod was wedged into the barrel so tightly that stress was set up at the end of the crosshead, or at the end of the fit just inside the barrel and failure developed as before. This condition occurs not only with the Laird-type crosshead, but is also found in the alligator-type, although not so frequently on the Milwaukee. Mr. Williams, has shown, however, that even the fits with smooth surfaces obtained by grinding do not insure complete freedom from this type of failure. Grinding removes tool marks, which certainly act to some extent as stress raisers. But the damage that can be done by the key may offset all that is gained by grinding.

Average Life of Piston Rods

The failures on the F-6 engines mentioned above practically all started in the same place as shown in Fig. 2. Fractures were located just back of the collar sometimes only 1/16 in. back and at other times further than this, probably depending upon where the fit terminated. The cracks were always on the top between the collar and the keyway; the piston rods could have been identified as left or right by this means alone had they not been marked otherwise. The cracks spread from the top squarely across the rod, never exhibiting angularity. Careful and complete examination, including analysis, test bars, etching, sulphur printing and micro-examination, was made of many of the first rods that failed without finding evidence of faulty material.

Table I—Average Composition and Physical Properties of Plain Carbon Steel Piston Rods 5¼ in. and 5½ in. in Diameter

Carbon	0.51 per cent	Yield point	53,000 lb. per sq. in.
Manganese	.60 per cent	Tensile strength	90,000 lb. per sq. in.
Phosphorus	.011 per cent	Elongation in 2 in.	26.0 per cent
Sulphur	.025 per cent	Reduction in area	45.0 per cent

The rods were made from plain carbon steel, normalized and tempered of the composition and properties shown in Table I. The service life of these rods, which were 5¼ in. in diameter, is shown in Table II.

An average life of 87,000 miles for a piston rod meant only about eight months of service. Even if all the cracked rods could be found on inspection so that there would be no failures in service this was not a very satisfactory situation. It was, therefore, decided to try some different types of steel to determine if longer life and greater freedom from cracking could be obtained.

The various steels listed in Table III were all tried. No. 1 was a chrome-nickel-molybdenum steel generally believed to be particularly tough in the quenched-and-tempered condition, especially in large sizes. The Brinell hardness number 235, seemed at that time rather high but this steel was known to have reasonably good machinability, and at this hardness could be handled satisfactorily. No. 2 was a manganese-vanadium steel, normalized and tempered which also had rather good ductility, high yield point, and higher strength than the plain carbon rods. No. 3 was a low-carbon-nickel steel, normalized and tempered. This steel had a high yield point and extremely high ductility but about the same tensile as the plain carbon steel. No. 4 was a high-grade wrought iron low in tensile strength compared with the steels but reputed to be tough. No. 5 was the same plain carbon steel which was used originally, but in the quenched-and-tempered condition. These rods had higher tensile, yield, and Brinell than any of the other rods and

Table II—Mileage of Carbon-Steel Piston Rods Normalized and Tempered

Diameter of rods	5¼ in.	5½ in.
Number of rods tested	74	74
Number of rods fractured	54	32
Rods worn to limit	5	15
Miscellaneous * (Not included in mileage)	15	14
Average mileage	86,900 (59 rods)	203,100 (60 rods)
Minimum mileage	10,300	23,500
Maximum mileage	214,200	460,800
Average mileage of rods worn to limit of wear	153,000	305,125
Rods still in service	None	13

* Includes rods removed on account of failure of some other part, rods removed and not reported, and others with records not clear.

appreciably lower ductility, especially elongation. They, of course, were not as easy to machine as the normalized rods but they did not offer any excessive difficulty. Micrographs of all but the iron rods are shown in Fig. 3.

The results obtained with these rods are presented in Table IV and offer some interesting indications even

Table III—Properties of Test Piston Rods (Chemical Analyses Shown in Per Cent)

	Chrome-nickel molybdenum No. 1	Manganese-vanadium No. 2	Low-carbon-nickel No. 3	Wrought iron No. 4	Quenched and tempered plain carbon No. 5
Carbon	0.36	0.28	0.27	...	0.51
Manganese	.56	1.46	.92	.07	.79
Phosphorus	.010	.024	.031	...	.025
Sulphur	.015	.023	.029	...	.041
Chromium	.77	.18	.14	...	.08
Nickel	1.44	...	2.54	...	...
Vanadium	...	.18	...	...	...
Molybdenum	.24	...	...	...	...
Yield point lb. per sq. in.	92,800	64,300	60,000	29,800	85,900
Tensile lb. per. sq. in.	115,900	93,300	86,000	45,800	130,000
Elongation in 2 in. per cent	24.0	24.0	32.0	28.1	18.0
Reduction in area per cent	63.4	58.6	62.0	40.4	45.2
Brinell	235	190	170	...	285 (surface)

though there were not enough of each type of rod tested to produce really conclusive results. However, since the service conditions were all very much alike and the rods were practically all being tested concurrently, on some of the 14 locomotives or the seven similar engines received about a year later, it is probable that the figures do reveal some real differences in the characteristics of the metals used.

It will be noted that the chrome-nickel-molybdenum rods did not in any case reach the limit of wear. The results with this steel were a distinct disappointment and there is nothing to show why they were not better. The wrought-iron rods, while they had low strength and not extremely high ductility, nevertheless gave good results from the standpoint of cracking in service. But the resistance to wear was low and the original cost was approximately twice as much as for plain carbon rods. The low-carbon-nickel rods were so soft they had poor resistance to wear. Although they are characterized by high ductility they were not proof against cracking. All the manganese-vanadium rods that were accounted for failed by cracking but the resistance to failure was very good as they ran to high mileages before cracks developed. The hard, plain carbon-steel, rods gave surprisingly good results. Although of high hardness on the surface they were sufficiently tough to resist cracking very well and

Table IV—Service Life of Special Piston Rods

Material (see Table III)	No. 1	No. 2	No. 3	No. 4	No. 5
Number of rods	7	6	16	8	6
Minimum miles	25,500	154,800	76,500	11,500	62,100
Maximum miles	178,150	201,800	180,800	124,000	247,800
Average miles	132,600	178,000	99,300	54,000	177,700
Number worn to limiting size	0	0	6	3	2
Number fractured	5	4	7	4	2
Accounted for otherwise	1* 1†	2*	3†	1*	2‡

* Bent through failure of other parts.
† No record.
‡ Poor fit.

did not crack at low mileage as did some of the soft rods. The resistance to wear also was good.

These results were responsible for the present practice of using quenched-and-tempered piston rods of plain carbon steel on these engines. It is apparent now from the few that have so far been put into service in the 5½-in. size of a modified design, that they do not have as great a tendency to crack as the softer, more ductile rods.

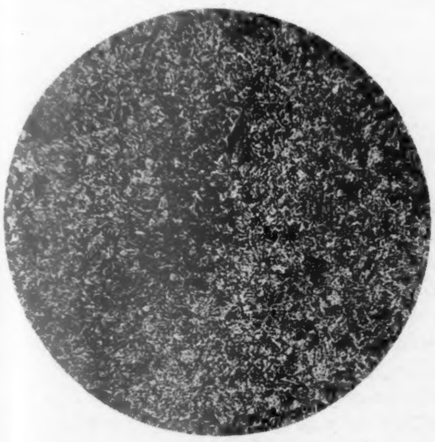
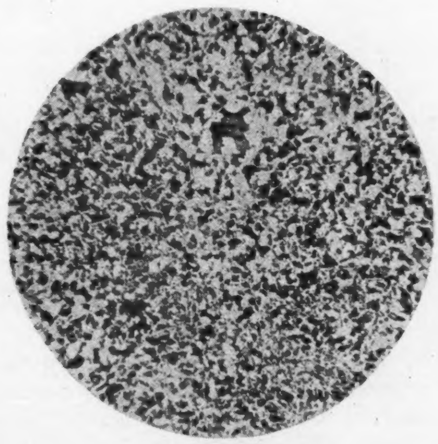
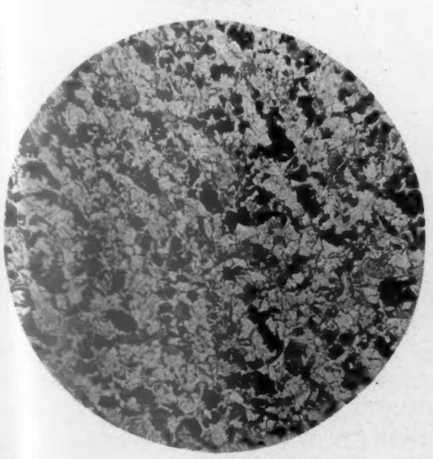
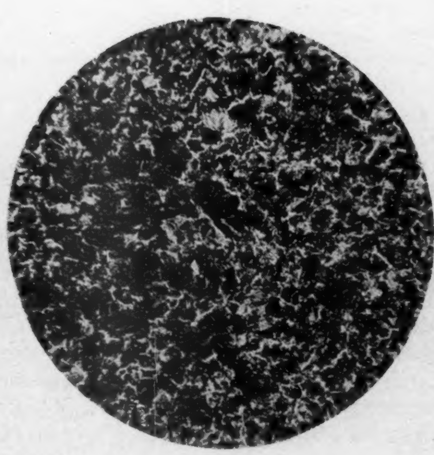


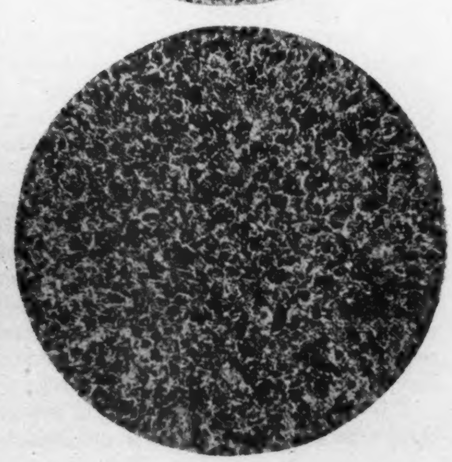
Fig. 3—Micrographs of steel piston rods tested on the C. M. St. P. & P.—100 diameters

Left—Chromium-nickel-molybdenum steel.
Right—Manganese-vanadium steel.
Lower left—Low-carbon-nickel steel.
Lower right—Manganese-vanadium steel.
Center—Quenched and tempered carbon steel.









None of the rods of the larger size have been in service long enough to permit estimating what the ultimate life will be. It will also be seen from Table V that the cost of the quenched-and-tempered rods is only a little greater than for a normalized-and-tempered rod of the same size and considerably less than the cost of the special rods.

Change in Size and Design

It was quite evident from the results of the tests of the alloy and heat-treated rods that they did not provide an entirely satisfactory solution to the piston-rod trouble. It was, therefore, decided to try a larger rod of somewhat different design. The new and old designs and sizes are shown in Fig. 4. The diameter was increased from 5¼ to 5½ in., the radius where the head joins the body was increased from 1 to 3 in., and the collar was omitted entirely. There did not appear to be any advantages in having the collar and there was a distinct possibility that it was a source of unknown and undesirable stress if the rod were drawn into the barrel of the crosshead far enough for the collar to act as a stop. The new style rods have now been tested quite extensively in plain carbon steel, normalized and tempered. The results obtained are shown in Table II along with the 5¼-in. rods. This shows that an increase of ¼ in. in the diameter of the rod raised the average life from 87,000 to 203,100 miles. The same quality of steel was used in the 5½-in. rods as was previously used in the 5¼-in. plain-carbon rods. Table VI brings out the great increase in life that resulted when the size and design were changed but, as is shown later, other factors probably influenced these results. It should also be borne in mind that the 5½-in. rods actually are even better than the tables indicate. There are still 13 of these rods in service and they have already averaged over 350,000 miles and one has exceeded 500,000 miles. When these are finally all removed the average mileage shown in the second column of Table II will be considerably more than the 203,000 miles shown.

Table V—Cost of Piston Rods of Varying Size and Chemical Analyses

Material	Approximate cost of rough-turned rods
Carbon steel normalized and tempered 5¼ in. diameter	$22.50
Carbon steel normalized and tempered 5½ in. diameter	23.00
Carbon steel quenched and tempered 5¼ in. diameter	29.00
Cr-Ni-Mo quenched and tempered 5¼ in. diameter	45.00
L-C-Ni normalized and tempered 5¼ in. diameter	38.00
Mn-V	38.00
S. A. E. 2340 quenched and tempered 5½ in. diameter	29.50
Wrought Iron	50.00

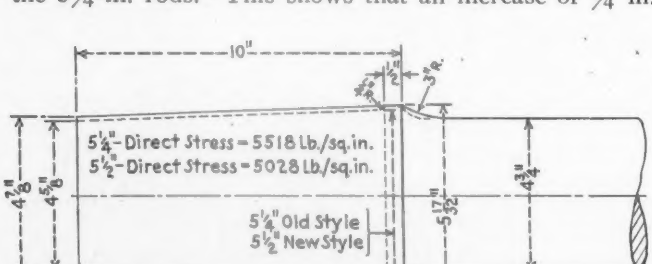


Fig. 4—Piston rod with new and somewhat larger crosshead fit which has shown good results on the Milwaukee

Quenched-and-tempered plain carbon rods of the new design and size are now standard for these engines and records are being kept to determine how much longer life they will have than the normalized rods.

The longer life and greater freedom from cracking shown by the 5½-in. rods is not believed to be due solely to the increase in diameter and change in shape. As shown in Fig. 4 the new design of rod has a direct stress only about 10 per cent less than the 5¼-in. rod.

One change that has been made in maintenance practice accounts for at least part of the decreased tendency to crack. The guides on one side of the locomotives have for some time been set a little closer together than on the opposite side. When the crosshead shoes wear one is scrapped and the other is transferred to the narrow side. In this way the amount of wear that is permitted to develop is kept low without any increase in the number of crosshead shoes consumed. By holding the clearance between the shoes and guides to a minimum there is considerably less whip of the crosshead at each end of the stroke. The stress is, therefore, also reduced and this must have a favorable effect in keeping the stresses induced by inertia forces to a minimum.

Rods Made from Hot-Rolled Round Bars

The latest type of piston rod that has been investigated and tried in service on the passenger engines is one from S. A. E. 2340 steel with approximately 3½ per cent nickel and 0.35 per cent carbon. The rods were machined from hot-rolled rounds 5¾ in. in diameter that had been quenched and tempered. This, of course, is a departure from standard practice since heretofore rods have always been made from billets by forging or pressing. The hot-rolled rounds are a cheaper source for a rough-turned rod than the hammered blanks. The test with four of these rods is not yet finished, one still being in service with an accumulated mileage in excess of 457,000 miles. One rod has reached the limit of wear.

Table VI—Mileage of Carbon Steel Test Rods Normalized and Tempered (Includes only those which wore to the limit or cracked)

	Per cent of 59 rods (5¼ in. dia.)	Per cent of 60 rods (5½ in. dia.)
0 to 100,000 miles	64.5	21.6
100,000 to 200,000 miles	34.0	35.0
200,000 to 300,000 miles	1.5	20.3
300,000 to 460,800 miles	0.0	23.1

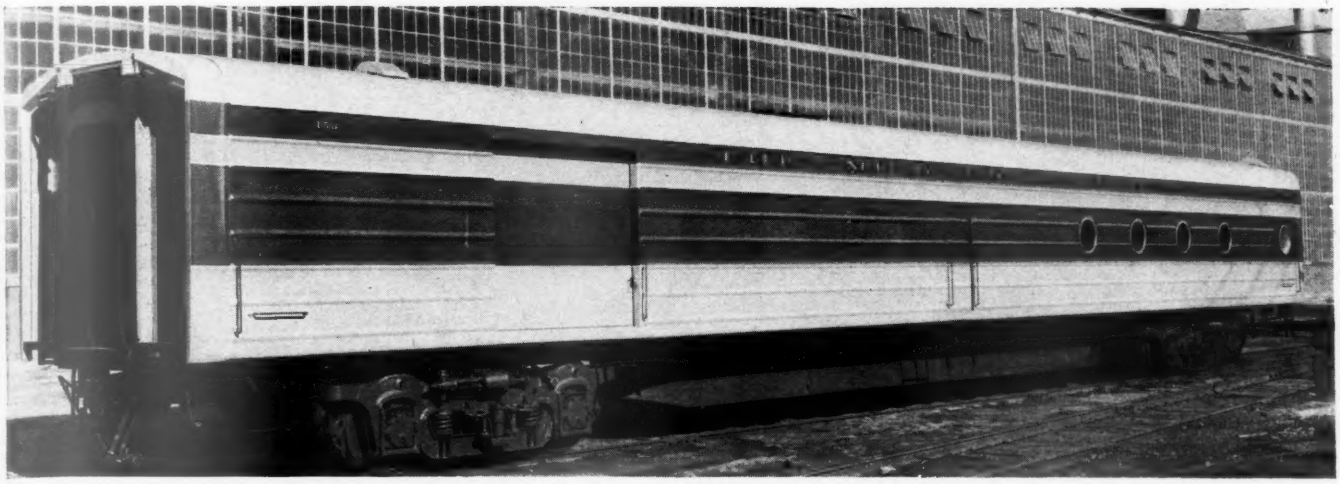
In the case of this particular rod it was applied to the right side of an engine at the same time that one of the 5½-in. normalized-and-tempered carbon rods was applied on the opposite side. These two rods remained on the engine and were removed at the same time because of both reaching the limit of wear after 367,100 miles of service. The nickel steel was not superior to the plain carbon steel in resistance to wear in this case. None of them were removed because of other failures which resulted in the rods being bent or otherwise damaged.

The average mileage at present of the four rods applied is 295,000, which includes one that was removed at 111,300 miles on account of being bent. The composition and physical properties are shown in Table VII. These rods do not have as high tensile strength as some of the special rods tested in the 5¼-in. size, but do appear to have fair resistance to wear and good resistance to failure. This suggests the idea that some of the rods

Table VII—Three and One-Half Per Cent Nickel Steel Rods Quenched and Tempered

Carbon	.37	Yield	78,000 lb. per sq. in.
Manganese	.66	Tensile	103,500 lb. per sq. in.
Phosphorus	.014	Elongation in 2 in.	24.0 per cent
Sulphur	.019	Reduction in area	59.5 per cent
Nickel	3.40		
Chromium	.15		
Silicon	.17		

(*Continued on page 104*)



Express-tap-room car notable for the use of circular windows in the passenger-section

Milwaukee Builds

More Welded Passenger Cars

Lightweight cars of alloy steel mark the third step in evolution of modern passenger rolling stock designed and built by this railroad

THE Chicago, Milwaukee, St. Paul & Pacific recently placed in service 35 new passenger-train cars which are being used primarily to replace former equipment on the Hiawatha. There are 15 standard coaches, 6 drawing-room-parlor cars, 4 beaver-tail parlor cars, 4 express-tap-room cars, 4 diners and 2 railway postoffice cars. The Hiawatha car equipment replaced by the new cars is being used in trains not previously air conditioned. The new cars, which were built by the railroad in its own shops, are of lightweight, alloy-steel construction, largely fabricated by welding. The designs are the work of the engineers of the railroad collaborating with Otto Kuhler, consulting engineer of design at New York, who was responsible for interior architectural treatment, decoration and arrangement of facilities.

In these cars focused lighting has been improved by fitting the lenses with metal louvers to eliminate practically all glare. The inside surfaces of metal car sides, ends, floors and roofs are treated with a plastic sound deadener. The air-conditioning system includes a more satisfactory method of air distribution than that employed in the cars of welded construction previously built by this railroad. The four-wheel lightweight roller-bearing truck is of entirely new design, utilizing coil-spring suspension exclusively in conjunction with hydraulic shock absorbers and including a bolster-stabilizing device to control sidesway. Rubber insulation is employed in the truck to an unusual degree.

These cars comprise the third set of new equipment for the Hiawatha. Each unit of the train consists of an express-tap-room car, four luxury coaches, a cafe-dining car, two drawing-room parlor cars and one beaver-tail parlor-observation car. The coaches and parlor cars have vestibules at one end only. The express-tap-room car and dining cars have no vestibules.

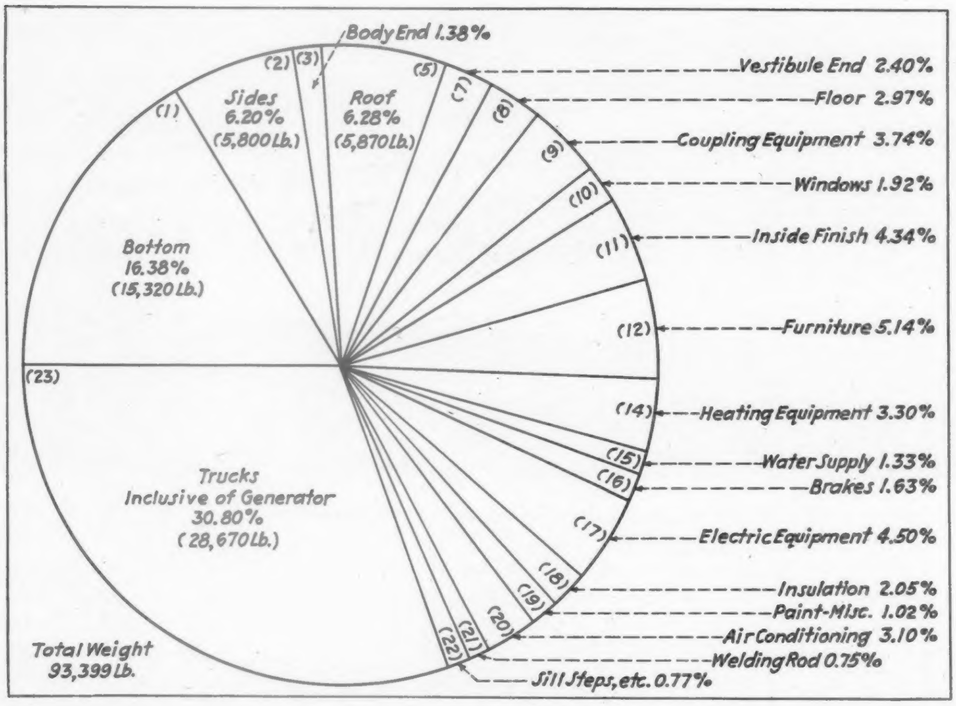
Structural Features of 1938 and 1936 Cars

The construction of the 1938 cars is very similar to that of the cars built in 1936. Cor-Ten steel is used throughout and the same fundamental principles of construction are employed. New window shapes and grouping of windows have been introduced in all cars, including the tap-room cars which have port-holes overlooking the tables. The underneath equipment is again suspended under the center of the car, but the shrouding is extended to present a smooth appearance from bolster to bolster.

The contour of the roof is slightly changed, circular arcs being substituted for the logarithmic curve previously used. This simplifies the fabrication of the carlines and permits the use of carlines rolled to contour instead of being die formed. The side construction is also modified to obtain more lateral stiffness by providing continuous longitudinal members above and below the windows, these members being formed by pressing. The intermediate side sheets are formed into

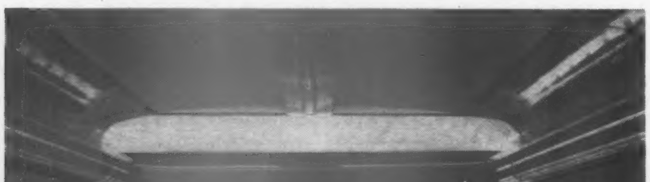
Scale Weights and Seating Capacities of Hiawatha Trains of the C. M. St. P. & P.

	1934 Hiawatha		1936 Hiawatha		1938 Hiawatha	
Type of car	No. of cars	Weight, lb.	No. of cars.	Weight, lb.	No. of cars	Weight, lb.
Express tap-room	1	131,500	1	96,200	1	98,800
Coach	4	448,800	4	379,600	4	373,600
Diner	..	......	1	102,300	1	105,400
Parlor car	1	113,700	1	95,100	..	......
Drawing-room parlor	..	......	1	95,200	2	186,600
Beaver-tail parlor	1	112,900	1	92,000	1	91,700
Total car weight	7	806,900	9	860,400	9	856,100
Number of revenue seats		238		291		300
Number of non-revenue seats		138		173		199
Total seating capacity		376		464		499
Car weight per passenger seat		2,146		1,854		1,716



Weight distribution of the Milwaukee 1938 coach

pans with flanges extending horizontally inward to the inside face of the side posts, and then vertically upward and downward along the post faces. The horizontal flanges of the side pans are slotted to receive the side posts which are threaded through the slots, each side pan being spot welded to the flanges of the posts in the flat section and arc welded to the post at the flanges of the pan. The window openings in the intermediate side



The large rear windows are an attractive feature of the observation room

sheets are cut out with a special torch. The intermediate side sheets, with their complement of side posts, form the principal elements of the side-frame assembly.

In the assembly of the side frame, the top, or letterboard sheets, and the lower side sheets are welded together in suitable clamps into a continuous length. The intermediate side-sheet assemblies are then laid in their proper sequence on the lower and upper side sheets and the side posts welded thereto. The flanges of the side pans are then securely welded together to form a continuous longitudinal stiffener.

The 1936 cars had corrugations in the side sheets above and below the wnidows only, while the present cars have a total of seven such corrugations, five extending the full length of the side while two in the side pan are interrupted by the windows. These corrugations also contribute to lateral stiffness and aid materially in obtaining smooth-appearing side sheets.

The floor construction is also modified slightly in that the pan construction is replaced by Z-shape floor supports welded to the floor beams. The side sills are increased from 3-in. to 4-in. Z-shapes, which not only strengthen the side construction but also afford better fastening for the floor supports and side posts to the side sills.

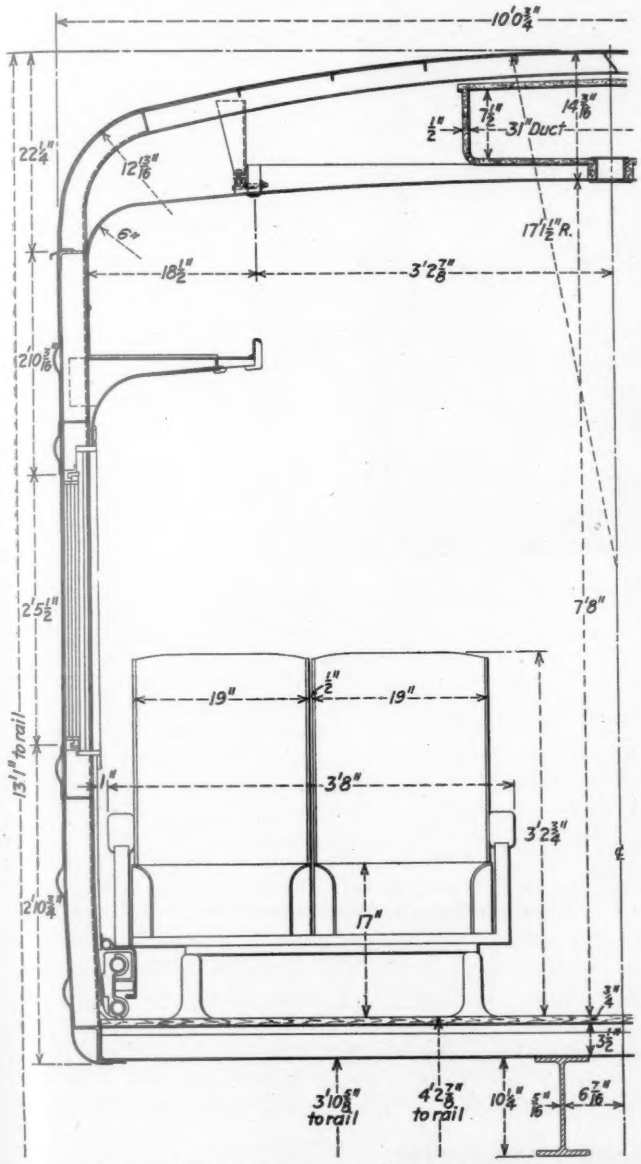
The interior arrangement is extensively modified by the total elimination of all metal trim. This includes the inside window sash, window frames and sills which, in the 1936 cars, were made of extruded aluminum and, in 1938 cars, are walnut. The other sash, however, are the same as used in 1936 and the inside sash are hinged in the same manner.

Heating is changed from a blast system to a combination of direct fin radiation along the floor, with positive air circulation provided by a blower. Air passing through the blower is tempered by means of a set of heating coils to offset the lower temperature of the fresh air taken into the car by the ventilating system. The floor radiation is of the new Vapor single-pipe arrangement in which the steam-supply pipe is inside the fin pipe. These changes in the heating system resulted in a considerable weight reduction. The method of air distribution is also changed and, instead of introducing the air into the car through grilles in the side walls, the air is now introduced through a trough in the center of the ceiling.

Details of Truck Construction

Important changes are also made in the trucks used under the new cars which are of the four-wheel, lightweight alloy-steel type, with conventional swing-motion

bolsters and spring planks and all journals fitted with Timken roller bearings. The truck, with the truck-mounted generator, weighs 14,961 lb., which may be compared with 15,913 lb. for the 1936 truck and 15,195 lb. for the 1934 truck. The non-generator equipped truck weighs 13,709 lb.



Half-section through the 1938 passenger cars of the C. M. St. P. & P.

Plywood Used on 35 Milwaukee Main Line Passenger Cars

Head-End Passenger Equipment

Floors: 1¼-in. 9 ply resin glued Douglas fir
Sides: ¾-in. 5-ply resin glued Douglas fir treated with a resin sealer to exclude moisture
Ceiling: ¼-in. 3-ply fir treated with a resin sealer

Passenger-Carrying Cars

Floors: ¾-in. 5-ply Douglas fir treated with a resin sealer
Wainscoating: ½ in. 5-ply bass wood with Mid-West walnut veneer face and 1/16-in. Kentucky poplar back coated with aluminum paint
Pilaster panels: Alternate fluted Mid-West walnut and ½-in. 5-ply bass wood with bleached curly maple face and Kentucky poplar back
Basket rack cove: 3/16-in. 3-ply bass wood with bleached curly maple face; trim is solid walnut
Ceiling: ¼ in. 3-ply poplar, covered with aluminum leaf on the exposed under surface
Partitions: ¾-in. 5-ply bass wood with bleached curly maple faces to window sill line; Mid-West walnut veneer used from then to the floor line
Doors: 1¾-in. 7-ply fir with Mid-West walnut veneer faces and solid walnut edges

Dining Cars

Stainless-steel-faced plywood in kitchen and pantry furnished by the Haskelite Mfg. Co., Chicago
Metal faced plywood with black enamel finish, used in men's rooms, supplied by the Metal-Wood Corp., Chicago

Partial List of Materials and Equipment on 35 New Milwaukee Main-Line Passenger Cars

High-tensile low-alloy steel for welded car structures	Carnegie-Illinois Steel Corp., Pittsburgh, Pa.
Aluminum sheets and tubing for baggage doors, air ducts, etc.	Aluminum Company of America, Pittsburgh, Pa.
Lightweight rolled-steel wheels	Edgewater Steel Company, Pittsburgh, Pa. Carnegie-Illinois Steel Corp., Pittsburgh, Pa.
Heat-treated carbon steel axles	Standard Forgings Company, Chicago
Roller bearings on all journals	Timken Roller Bearing Company, Canton, Ohio
Truck and car end castings	General Steel Castings Corp., Granite City, Ill.
Truck coil springs, alloy steel	Railway Steel Spring Company, New York, N. Y.
Unit-cylinder clasp brakes	American Steel Foundries, Chicago
Self-locking truck center pins	W. H. Miner, Inc., Chicago
Air brakes, Schedule H. S. C.	Westinghouse Air Brake Co., Wilmerding, Pa.
Safety hand brakes, Ideal	W. H. Miner, Inc., Chicago
Couplers and yokes, high-tensile cast steel	Buckeye Steel Castings Co., Columbus, Ohio
Friction buffers and draft gears	W. H. Miner, Inc., Chicago
Rubber used in truck construction	United States Rubber Co., New York, N. Y.
Coupler and buffer stem wear pads	Fabreeka Products Company, Boston, Mass.
Bolster vertical shock absorbers	Monroe Auto Equipment Co., Monroe, Mich.
Steam jet air-conditioning system	Safety Car Heating & Lighting Co., New York, N. Y.
Heating equipment and temperature control	Vapor Car Heating Company, Chicago
Car lighting generators, 10 kw	Safety Car Heating & Lighting Co., New York, N. Y.
Electric storage batteries	Electric Storage Battery Co., Philadelphia, Pa. Gould Storage Battery Co., Depew, N. Y.
Charging receptacles	Albert & J. M. Anderson Co., Boston, Mass.
Electric exhaust fans	Holmes Fan Company, Chicago
Air filters	Air-Maze Company, Chicago
Water coolers	Ebco Mfg. Company, Columbus, Ohio
Hardware and anti-pinch hinges	Loeffelholz Company, Milwaukee, Wis.
Truck lock washers	A. M. Castle Company, Chicago
Self-tapping screws	Shakeproof Lock Washer Co., Chicago
Insulation:	
Stonefelt, 2½ in. thick in floors	Johns-Manville Sales Corp., New York, N. Y.
Hair felt around air-cond. ducts	American Hair & Felt Co., Chicago
Dry Zero, flameproof, 2½ in. thick in sides, ends and roofs	Dry-Zero Corporation, Chicago
Cork board, 2½ in. thick in ice boxes, bottle lockers, etc.	Armstrong Cork Prod. Co., Lancaster, Pa.
Felt stripping used between inside metal sheets and posts	Western Felt Works, Chicago
Dednox applied to inside metal sheets for sound deadening	Dednox, Inc., Chicago
Pipe covering	Johns-Manville Sales Corp., New York, N. Y. Union Asbestos & Rubber Co., Chicago
Ventilators	Railway Utility Company, Chicago
Wash stands	Standard Sanitary Co., New York, N. Y.
Hoppers	Duner Company, Chicago
Outside window sash	Adams & Westlake Company, Elkhart, Ind.
Glass—De-hydrated sash used in observation car ends	Pittsburgh Plate Glass Co., Pittsburgh, Pa.
Window shades	Railway Curtain Company, Chicago
Lighting fixtures	Loeffelholz Company, Milwaukee, Wis.
Coach seats	Heywood-Wakefield Company, Boston, Mass. Coach & Car Equipment Co., Chicago
Dining car chairs	General Fireproofing Co., Youngstown, Ohio
Observation lounge chairs	American Chair Company, Sheboygan, Wis.
Plush seat covering and drapes	L. C. Chase & Co., Inc., New York, N. Y.
Plush seat covering	Massachusetts Mohair Plush Co., Boston, Mass.
Leather seat covering	Cleveland Tanning Co., Cleveland, Ohio
Ajax drinking cup dispensers	Logan Drinking Cup Company, Chicago
Radio and loud speakers	Galvin Mfg. Company, Chicago
Marker lamps	Pyle-National Company, Chicago
Stainless steel-faced plywood in diner, kitchen and pantry	Haskelite Mfg. Company, Chicago Metal-Wood Company, Chicago
Plywood for car interiors	Algoma Plywood & Veneer Co., Chicago Harbor Plywood Co., Hoquiam, Wash. Wheeler-Osgood Co., Tacoma, Wash.
Exterior paints	Murphy Varnish Co., Chicago

One feature of the new truck design is the entire elimination of elliptic springs which are replaced by large triple-coil alloy-steel spring groups, the outer spring being 14 in. in diameter. These spring groups have a difference of 14 in. between the free height

One of the parlor cars—the interior finish is American walnut and bleached maple—louver lights are shown under the luggage racks

and the working height, thus providing an unusual degree of flexibility and "spring."

To promote easy riding by the damping of vertical oscillation, the truck is equipped with Monroe hydraulic shock absorbers applied between the bolster and the spring plank, one on each side of the truck. Automotive-type levelizing bars also extend across the truck frame and are connected to the bolster by swing hangers. These bars operate in such a way as to steady the bolster and keep it level by transferring or equalizing the unbalanced load on the bolster springs when one side of the truck moves up or down due to irregularities in the track surface. The trucks are equipped with medium lightweight, rolled-steel wheels, heat-treated carbon-steel axles, General Steel Castings truck frames, Simplex unit-cylinder clasp brakes and Westinghouse H. S. C. air-brake equipment. To assist still further in smooth train handling when braking, Miner velvet-action passenger draft gears are installed.

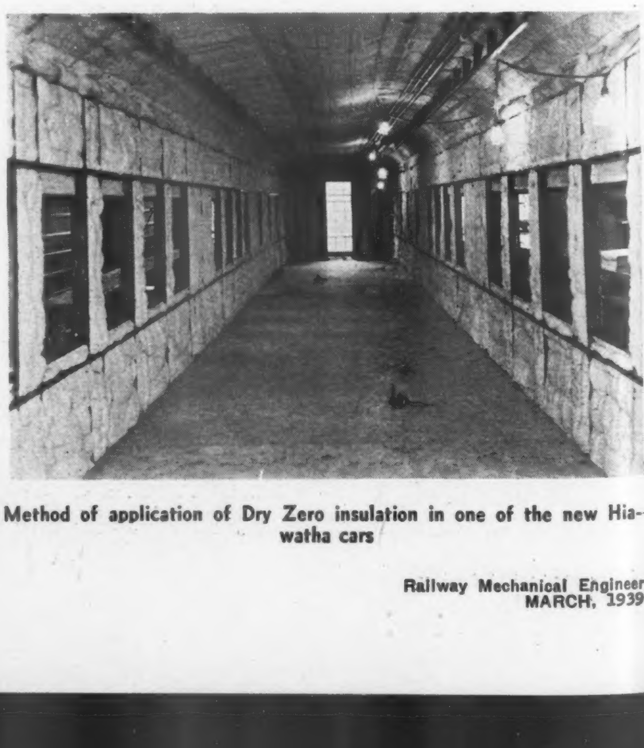
Another feature of the new truck is the extensive use of rubber to dampen vibration and eliminate shock and noise in so far as possible. For example, a circular rubber pad 1-in. thick in the bottom of each bolster center plate carries the car weight, and vulcanized steel and rubber segments line the center-plate flange. The Miner self-locking truck center pin is rubber-bushed. Circular rubber pads are applied on top of the large bolster coil springs. Bolster bumper blocks are made of rectangular rubber pads. Bolsters are positioned by four large rubber-insulated bolts which prevent bolster contact with the chaffing plates. Rectangular rubber pads are applied under the friction side bearings and the holding bolts are also set in rubber. The generator-support bearings are made of rubber and the Monroe bolster snubbers are insulated by four rubber bushings. The levelizing bar and hangers also are rubber-bushed and a rubber hose is used to cover the hand-brake wire cable.

Car Parts Made at Milwaukee Shops

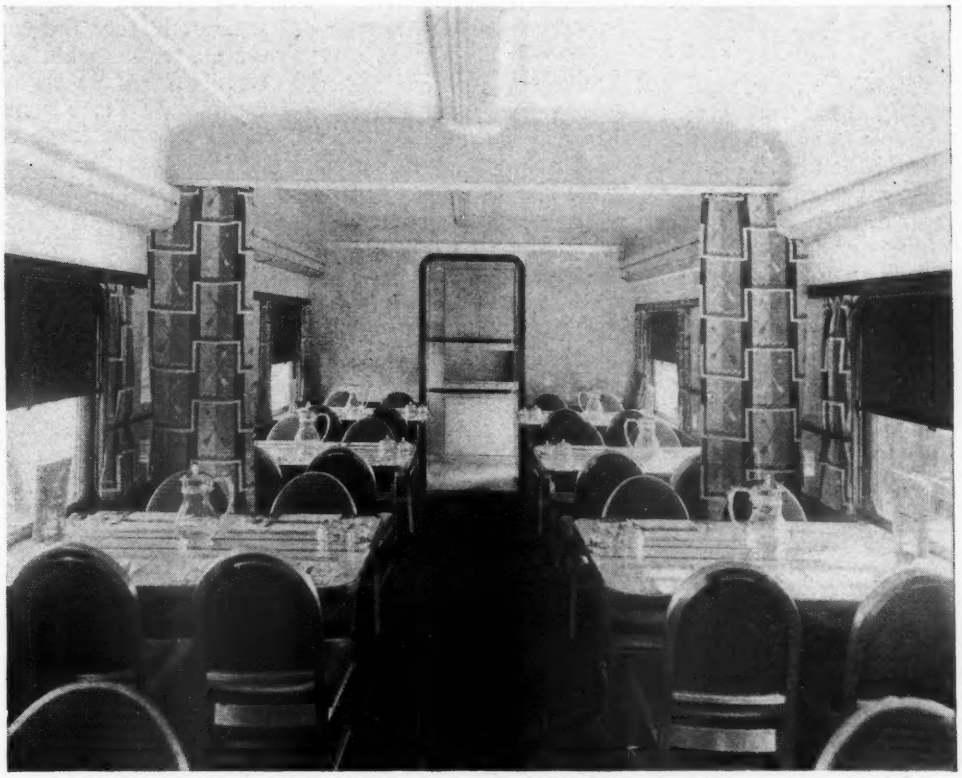
In addition to fabricating Hiawatha car structures by the welding process at Milwaukee shops, the following car parts were manufactured locally: Truck equalizers, made from flame-cut and welded I-beams; bolster swing hangers, forged; friction side bearings; roller-bearing housings, inner and outer; generator and axle pulleys, V-belt type; diaphragms, inside and outside; folding vestibule steps; air ducts and grilles; water tanks; basket racks; interior finish, American wood veneers, including doors, partitions and side walls; bar fronts; aluminum baggage-car doors, and wood smoking-room furniture. A feature of these cars is the extensive use of plywood on the interiors. The various locations are shown in the table.

Interior Appointments of the New Cars

The general scheme of interior decorations of these cars centers around the use of native woods and softness rather than brilliance of tone in color and ornamentation. The interior finish of the walls is in native walnut and bleached maple, and most of the exposed metals in ash trays, window hardware, etc., is a dark gun-metal finish. Stainless steel or brush-finished chrom-



Method of application of Dry Zero insulation in one of the new Hiawatha cars



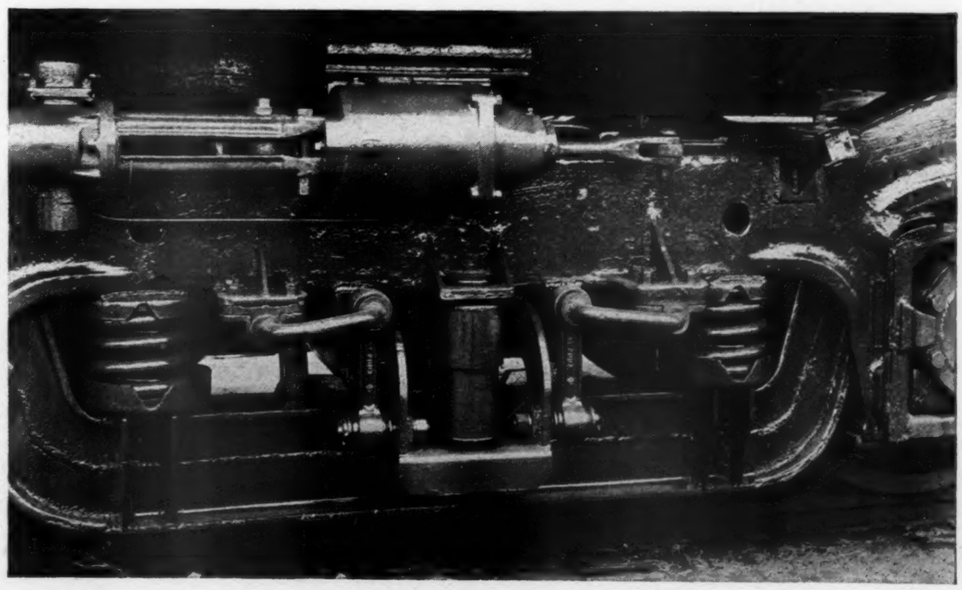
Looking toward the cafe section in the dining car

ium has been used only on vestibule door handles, handrails, etc., where the gun-metal finish would not withstand the effect of constant handling.

The express-tap-room car has a 30-ft. space in the forward end available for baggage and express, and a 41-ft. 6 in. cocktail-lounge and tap-room section seating 44. Adjoining the bar, which is across the front end of this part of the car, is a cocktail lounge seating 12 persons. The lighting is indirect, coming from lamps which are placed behind the ceiling bulkhead which divides the cocktail lounge from the tap room.

The tap room is fitted with tables and transverse seats, arranged section-wise. Longitudinal louver lights are placed at the lower edge of the ceiling. These shed light directly on the tables and about 50 per cent is spilled under the canary-yellow ceiling to produce a soft glow throughout the room. The ceiling air duct is made from Burgess perforated aluminum formed in an ornamental shape and trimmed at the bottom with a curved batten strip. This same arrangement is used throughout all the cars. The floor is covered with rubber of neutral brown closely matching the walnut trim.

Each of the luxury coaches has a 6-ft. women's lounge in one end, seating 5; a 49-ft. 8 in. coach section, seating 56, and an 11½ ft. men's lounge in the other end, seating 9. The individual reclining chairs, with backs which may be locked in any desired position, are upholstered in old rose and green velour in alternate cars. The ceilings are covered with aluminum leaf. The outside window sash are of extruded aluminum. The inside sash, however, are of walnut, and sealed to the outside sash by small gun-metal-finished locks. Louver-type lighting fixtures are located from each beam in the face of the continuous luggage racks in the coaches and parlor cars. Grilles in the face of the Holophane lenses serve to remove the edge glare from this type of fixture



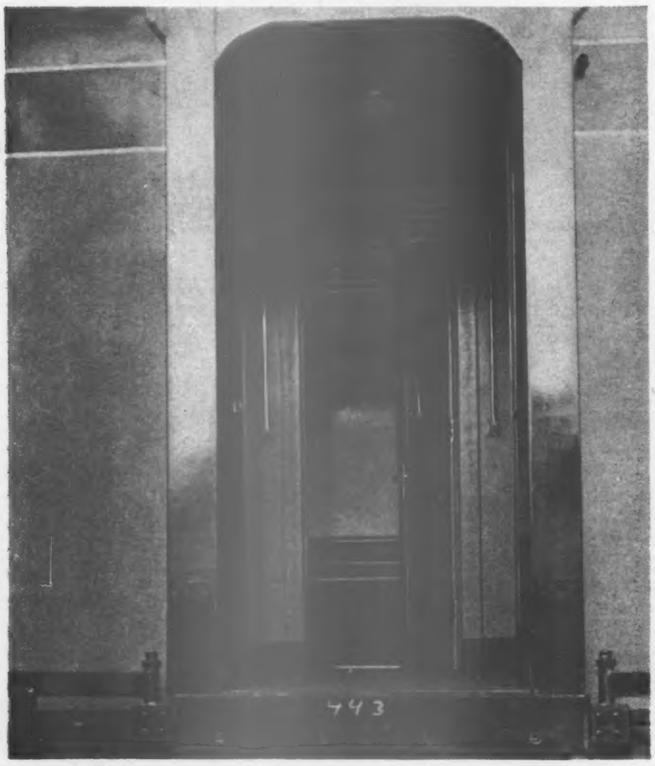
The truck, showing coil spring suspension, hydraulic shock absorber and levelizing bar

and play an important part in the decoration of the car.

The Dining Cars

The dining car, equipped with an 18-ft. 9-in. kitchen, a 9-ft. 6-in. pantry, and a 6-ft. refrigerator and linen locker section, has a cafe section 12 ft. 8 in. long which seats 16, and a main dining compartment 25 ft. 4½ in. long which seats 36, giving a total seating capacity of 52. This dining car is equipped with aluminum chairs. The dining-car tables are bracketed to the wall, making the dining-room floor completely accessible for cleaning without the obstruction of table legs. The rubber table tops are cream with inlaid brown stripes. A plain, modern buffet is installed at the kitchen bulkhead.

The walls and ceilings of the kitchen and pantry are covered with sanitary stainless steel. A new blower arrangement supplies cool filtered air in the kitchen and pantry. The conventional coal range is replaced by a modern hotel range designed to burn propane gas with resultant fuel saving and lower kitchen temperatures.



Vestibule door equipped with anti-pinch hinges—chromium-plated vestibule safety bars are shown locked in the raised position

Parlor and Observation Cars

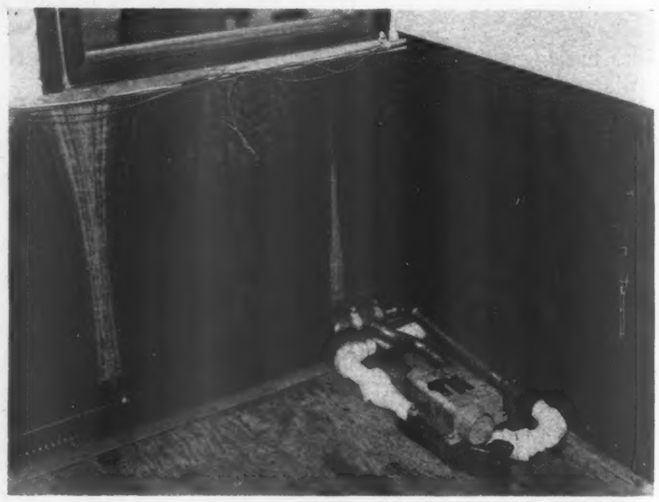
Each of the drawing-room parlor cars has a 6-ft. women's lounge in one end, seating 5; a main parlor section 44 ft. 4½ in. long, seating 24; a 6-ft. drawing room, seating 5, and a 7-ft. men's lounge in the other end, seating 5. The parlor car is equipped with luxuriously upholstered revolving reclining-back seats. A drop table is placed at each seat. In the drawing room a studio couch is quickly convertible into a bed and two pull-up chairs make the drawing room ideal for small parties desiring privacy.

The beaver-tail parlor-observation car has a 7-ft. lavatory section in one end; a 50-ft 8-in. main compartment or drawing-room section, seating 28, and an 18-ft. 3½-in. observation-lounge, seating 17. The observation-lounge, which is open to all parlor-car passengers, is separated from the chair section of the car by a partially glassed bulkhead. A wide sofa for three faces the rear. The exterior fins on the rear of the beaver-tail car add to the structural strength, and the horizontal fins shade the large sloping windows from the direct rays of the sun.

A new design of diaphragm enclosing the outer space between the car ends gives the train a smooth unbroken appearance and also serves to keep dust out of the vestibules. To further reduce air resistance underneath the train, retractable steps that are raised when the train is in motion have been installed at each vestibule. Hinged chromium-plated safety hand bars are available to passengers going through the vestibules from one car to another.

Exterior Treatment

In order to improve the outside appearance as well as to provide a cleaner-looking train when in service a rearrangement of the two standard Milwaukee exterior colors—yellow and maroon—has been worked out for the new cars. In the Hiawatha cars built in 1934 there was a maroon letterboard and a maroon belt at the lower edge of the cars, with the sides finished in yellow. Thus the dark windows were emphasized in a background of light color which tended to make the windows look smaller than they actually are and to appear as single units rather than part of a continuous speedline panel. For the cars built in 1937 the side sheets were pressed to form continuous beading above and below the windows which effected some improvement by tying the windows together. In the new cars the yellow between the windows has been replaced by maroon, thus fitting the dark-appearing windows into a continuous panel of dark color along the sides of the train. To effect a lowering in the appearance of the sides of the cars the maroon bottom belt has been left off and the yellow field below the windows extended to the bottom of the car side. The gray of the roof contrasts effectively with the maroon color of the letterboard, tending to give the cars a long, low appearance.

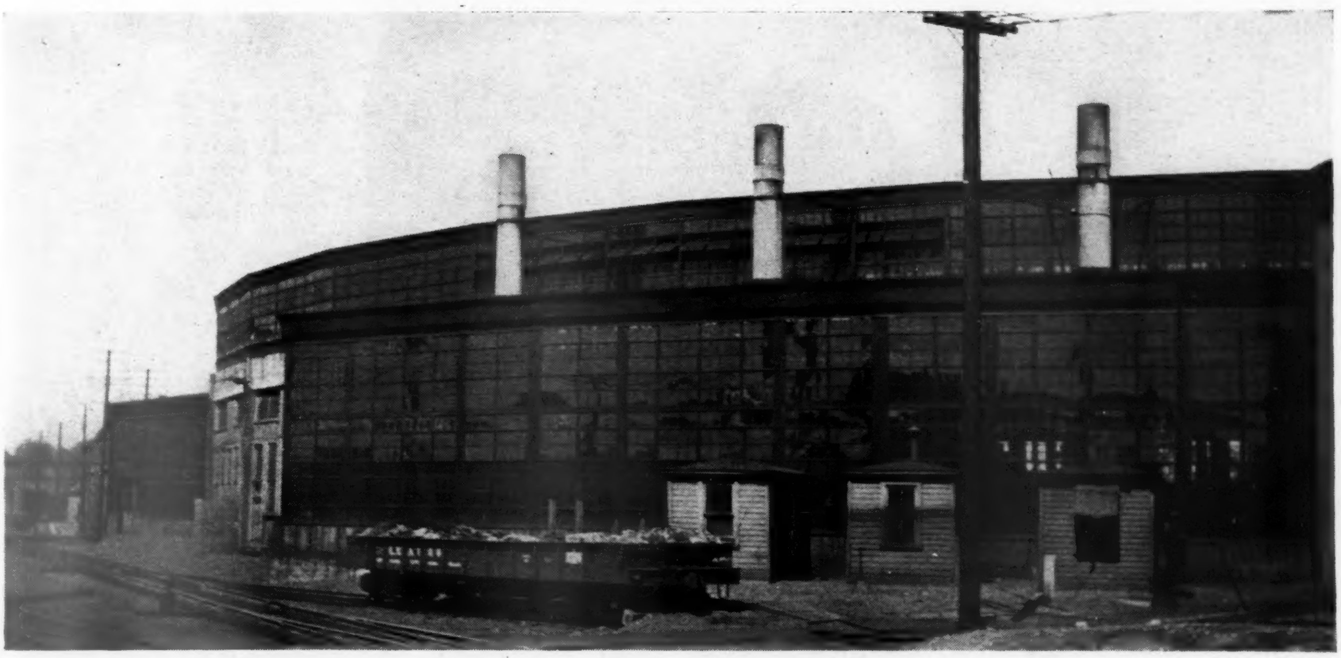


A section of the new Vapor copper-fin single-unit heating pipe and magnetic heat-control valve

Porthole windows are built in the sides of the express-tap-room cars. Windows of the same type have also been employed in the vestibule doors and in the toilets and passageways at the ends of the coaches and parlor cars opposite the vestibules.

Improved Facilities Feature

Modern B. & L. E. Enginehouse



Rebuilt B. & L. E. enginehouse at Greenville, Pa.

Better lighting, ventilation, more headroom, and improved facilities for making running repairs are included in the rebuilt Greenville enginehouse

During last year the Bessemer & Lake Erie rebuilt its enginehouse at Greenville, Pa., in order to provide better lighting, ventilation, more head room, and improved facilities for making running repairs to locomotives. The enginehouse, originally completed in 1911, was built of reenforced concrete and contained 17 stalls each 90 ft. long. At that time the stalls were of ample length to handle the power then in use, but the purchase of 2-10-4 type locomotives in recent years necessitated longer stalls.

The enginehouse is suitably located in the shop yard, both with reference to the work of servicing locomotives and to other shop buildings and facilities. It is situated so that ten stalls, six at the north end and four at the south end, could be extended without interfering with adjoining buildings and facilities. During 1937 these ten stalls were extended 27 ft. each, and diagonal or skewed walls were built where they adjoin the shorter stalls. During the recent building, the roof over the seven stalls not extended was rebuilt as a monitor and raised to the same height as that of the other ten stalls.

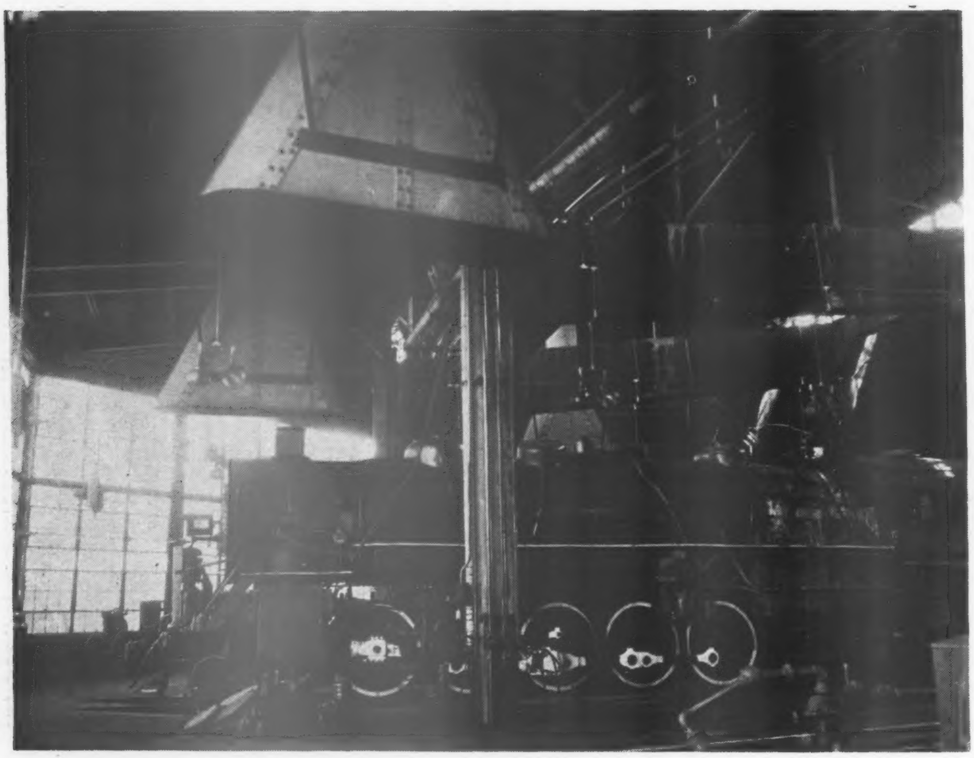
Layout of main steam and water pipes and electric conduits

The concrete roof, purlins, monitor, and rear curtain walls were removed from the old building but all radial concrete beams and columns were used for supporting the new construction which was built up on them and connected to the old concrete. The new construction is of welded steel. Continuous steel sash windows, to furnish ample lighting for the building during the day, were installed at the front of each stall and on both sides of the monitor. A continuous ventilating sash, manually operated from the floor, was provided in all stalls.

Lighting

The question of providing suitable lighting for the enlarged building was given very careful consideration. The lighting in the old building followed the common practice at the time the building was erected, but was now entirely inadequate. It was necessary to use hand torches and extension lines on dark days as well as at night. The decision was made to discard the ordinary practice and design an installation to suit the requirements of the enlarged building.

A comprehensive study including the size and shape



Smoke jacks with 12-ft. asbestos-board bells and 36-in. diameter stacks are used in the B. & L. E. Greenville enginehouse

of the building, stall layout, and the position of smoke jacks, pillars and jib cranes was made. Owing to the frequent presence of a smoke and steam ceiling, it was essential to keep the lighting units below this level so that the light would not be absorbed in this heavy atmosphere. The final decision was that, under the conditions, individual lights for each side of the locomotive would be required and each stall could be treated as an individual lighting problem, with angular lighting units directing light to the side of the locomotive rather than the conventional vertical mounted unit.

The corrosive atmosphere and the presence of sulphuric-acid fumes made it necessary to have a fixture especially designed for these conditions. The unit as finally designed is dust and moisture proof with all parts impervious to attack from the fumes.

The light required at the rear (towards the turntable) of the enginehouse is less than at the front. The stalls here are so close to one another that vertical-mounted units with the light directed to the floor, with special spread lens, were installed. The final spacing and focusing of the fixtures was definitely decided after a trial installation and the final layout made accordingly.

The wiring of the house and the hanging of the units have both been done in a unique and satisfactory manner. The units are mounted on hangers that are resilient to shocks and permit them to swing through a small arc in case they are bumped. The units focused angularly are mounted on tee-shaped conduit hangers with the bar of the tee nearest the floor; one lighting unit is mounted at each end of the bar and the two units on the bar are focused on locomotives in adjacent stalls.

The main power feeders to the house have been brought into a De-ion breaker panel board and the circuit feeders taken from there. The De-ion panel-board arrangement eliminates the necessity of fuses and prevents tampering. At the main panel board are four circuits used to control night lights, which are the first front lights in each stall and are kept lighted at night on account of the passageway around the stalls, which is kept open at all times.

The branch circuit switching for controlling the lights in each stall is located at the front column and is also De-ion breaker controlled. Every other rear column has a group of three breakers and the intermediate ones have four. The group of three breakers is so wired that one breaker will turn on three lights on the one side of the locomotive, a second breaker will turn on three lights on the one side of the locomotive in the adjacent stall, and the third breaker will turn on the two rear lights which are focused to the floor. The group of four breakers operate the same except that the fourth one is used to control a plug-in receptacle circuit for extension cords.

With this mounting and switching arrangement any particular part of a locomotive on which men happen to be working can be lighted, which results in economical operation and low maintenance.

All electric equipment and fixtures were furnished by the Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa., and installed under their general supervision by the railroad company forces.

Heating

The old concrete enginehouse was heated by an exhaust-steam system by means of pipe coils along all walls and by pipes on each side of the engine pits. The system was installed at the time the enginehouse was built. The exhaust steam was supplied from the power house by a large main in a conduit; various other buildings were supplied from the same main and the demand for steam was becoming in excess of the economical supply. The system was also becoming obsolete and was inadequate to care for any larger building, particularly one of the size and requirements of the enlarged enginehouse.

After a study of improved steam heating and other methods it was decided that a unit-blower heating system with live-steam supply, for the heating unit, would best meet the present requirements. The live steam at a pressure of 120 lb. is furnished by a main carried overhead around the front of the stalls. Steam is carried by branch pipes to each unit heater. Sixteen units, one between each two stalls, were installed. Each unit is a two-fan unit heater, supplying 6,200 cu. ft. per min. and is located about 5 ft. from front columns with the base 12 ft. above the floor. Each unit is separately con-

Each stall is treated as an individual lighting problem, with angular lighting units directing light to each side of the locomotive and with vertical units over the tender

nected and controlled by a hand-operated switch so that one or all can be working at any one time and temperature controlled as found necessary. The louvers in front of the heater are adjusted for height and location of the unit. Two heaters were installed for trial and later 14 more were added to complete the layout.

The old steam heating system, including the pipes in the pits and in the conduit at the front of the enginehouse, were entirely removed.

The heating units as finally installed were furnished by Ilg Electric Ventilating Company, Chicago.

Washout System

A locomotive washout and refilling system was installed at the time the enginehouse was built. The pump, tanks, and equipment were located in an annex adjoining the enginehouse on the south. The piping was carried in concrete conduits with connections for blowing off, washing out, and refilling locomotives furnished for each stall.

In 1937 the system was obsolete and inadequate for present conditions and for the larger locomotives now

Night views in the old and new B. & L. E. enginehouse

in use. In connection with the extension and enlargement of the enginehouse, the old facilities were retired and larger ones of latest design installed.

The new pumps and equipment are located in the room in the annex occupied by the former system, and the washout and refilling tank placed just outside of that building. All piping is carried overhead to the enginehouse and overhead on hangers around the front of stalls. Connections are taken from these overhead pipes, carried to the columns and down the columns to supply each stall. The system was furnished and installed by the F. W. Miller Heating Company, Chicago. Company forces removed the old plant, installed all foundations, the pipe carriers in the enginehouse, and prepared the layout for the actual installation.

Smoke Jacks

The smoke jacks in the old building, put in when the building was erected, were all double, consisting of two jacks each with a bell 10 ft. long joined at the ends and covering 20 ft. of the stall. Twelve pairs were of asbestos board and five pairs were of cast iron. These were all in need of replacement and were taken out and new single jacks, each with a bell 12 ft. long, and with a 36-in. diameter circular stack, were installed. The bells are of asbestos board and the stack of Transite pipe. The jacks, including the stack, were furnished by Johns-Manville Corporation.

General

All piping in the building is carried overhead, the main pipes of all kinds being on the hangers near the front of the building. This new arrangement permitted the removal of the old pipes which were all carried in the conduit at the rear of the building, and the conduit will now be used exclusively for drainage purposes. All new piping is welded at all joints and connections. Electric conduits and wiring are also overhead, the main conduit being supported on the hangers which also carry the other pipes.

A new hard surface floor, built up on a crushed-stone base with a prepared asphalt concrete top, was laid for the entire building. This will provide a floor comfortable for the men to work on and at the same time provide for easy handling and operation of trucks and movable cranes and machines. The entire project, including both design and construction work, was carried out by the railroad company employees under the direction of the chief engineer.

Serviceability of Heavy-Duty Pistons

(*Continued from page 94*)

found unsatisfactory in the smaller size might be much more successful in the 5½-in. size.

The authors are not satisfied that differences in service life, where the rods wore to the limit, obtained with the different kinds of steel is related directly to the wear resistance in each case. Certainly the results have not been consistent with what might be expected from other experiences with these materials. Possibly some unsuspected changes in the lubrication or priming and foaming of the boiler have produced conditions unfavorable to the development of maximum life.

The rather low ductility of the quenched-and-tempered steel is not believed to be detrimental. Rigidity, or stiffness, appears to be the property that is essential to meet the operating conditions where these rods are used. The fracture at a relatively short life of the rods with high ductility seems to bear this out. The soft rods flex more than the hard ones and the fatigue strength is exceeded at such frequent intervals that cracks soon develop. It is also possible that with the hard rods a larger portion of the stress is transferred into the crosshead through yielding of the lower strength steel of the crosshead.

Slipping Tests of Steam Locomotives

(*Continued from page 90*)

lb. The play between the rail and tie plate as well as the rail depression was measured. Recommended practice followed in this procedure is given in the Proceedings of the A. R. E. A., Vol. 35, page 294. The values of the modulus were found to vary from 1,060 lb. to 3,460 lb. per in. per in.

[Note—The results and a discussion of the slipping tests will be included in Part II of this paper which will

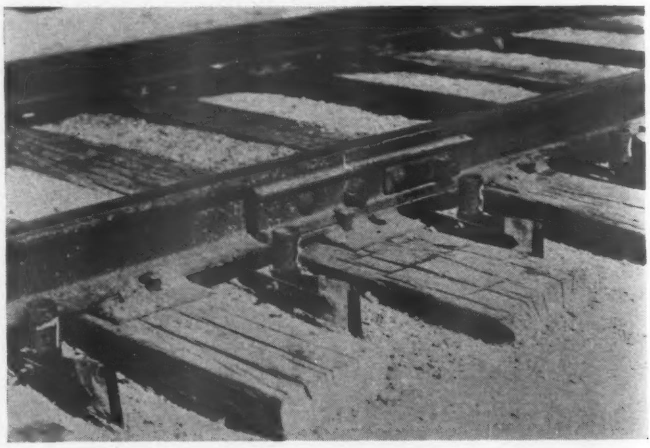


Fig. 12—Lever-type rail deflection gage

appear in the April issue. The text of Part I includes only a general discussion of the background leading up to the tests, a description of the preparations for making the tests and a presentation of the basic data concerning the locomotive tested. Included in Part I are a set of four pictures made from the 400-frame-per-second motion pictures showing the main driving wheel as it approached the maximum of ⅞-in. off the rail. There are also six charts covering the 4-6-4 type locomotives. Reference to these and similar charts covering the 4-8-4 and 2-10-4 type locomotives will appear in Part II.—Editor.]

Burlington's Ninth Zephyr Named "General Pershing."—The ninth "Zephyr" of the Chicago, Burlington & Quincy, which will be placed in service between St. Louis, Mo., and Kansas City early in April, will be named the "General Pershing," in honor of one of Missouri's most illustrious sons. The commander of the American Expeditionary Forces was born near Laclede, Mo., on September 13, 1860. His father was John F. Pershing, a section foreman on the Hannibal & St. Joe (now part of the Burlington). In addition to carrying the name, "General Pershing Zephyr," on the front, the four cars will be named the "Silver Charger," the "Silver Leaf," the "Silver Eagle" and the "Silver Star." The General Pershing will team with the Mark Twain, also named after a Missourian, Samuel L. Clemens, in a double daily operation between St. Louis and Kansas City. In addition the new train will provide accommodations for passengers between St. Louis and Denver, Colo. The order for this train was announced in the October, 1938, *Railway Mechanical Engineer*.

EDITORIALS

A Boiler Problem

One of the problems which causes the greatest tax on the ingenuity of those employees on the railroad who are concerned with locomotive boiler design or maintenance is the patching of boiler sheets. Many patches, if not exactly alike, are so nearly alike as to be dealt with in a more or less routine manner. However, occasionally a patch is required at a location which creates a real problem, either in the design of the patch or in its application, or both, the solution of which draws upon all of the knowledge, skill and ingenuity of every one who has anything to do with it.

Do you recall any interesting cases of this kind with which you have had to deal? The *Railway Mechanical Engineer* offers two prizes for concise articles describing the most interesting problems of this kind submitted to us on or before May 15—a first prize of $30 and a second prize of $20. The article must describe a patch which has actually been installed on a locomotive and which is known to be designed with adequate efficiency. The unusual conditions which had to be met should be clearly set forth including either interesting methods of application or of patch design, or of both, as the case may be. In picking the prize winners, the articles will be judged not on the quality of the English composition, but on the interesting character of the problem and the way in which it was worked out.

The text of the article should be accompanied by sketches or photographs, or both, if available and necessary. Keep the text as short as clearness will permit.

All articles submitted will become the property of the *Railway Mechanical Engineer.* Those other than prize winners which are published will be paid for at regular space rates.

Forced Vibrations In Locomotive Operation

Elsewhere in this issue appears the first part of a paper by T. V. Buckwalter and O. J. Horger before the February meeting of the New York Railroad Club in which are set forth the results of some very interesting and significant steam locomotive slipping tests. These tests deal with the phenomena of the jumping main driving wheels which have been encountered on several steam locomotives designed for high-speed operation when slipping at high speeds.

For many years occasional locomotives with badly balanced driving wheels have been the cause of track damage when operating at high speeds. In these cases, however, the distance between the location of rail kinks coincided with the circumference of the wheel and they occurred at speeds sufficient to develop a dynamic augment greater than the wheel load. In the case of the new phenomena, however, the jumping occurs at speeds lower than would be required for the lifting of the wheel under the influence of the dynamic augment of the overbalance alone and has occurred while the locomotive was slipping at high speeds.

The tests described by Mr. Buckwalter in his appearance before the New York Railroad Club have involved an interesting application of motion picture photography and are correlated with a mathematical analysis of the forces involved on the assumption that the lifting of the wheel is the result of the forced vibrations. The factors are wheel and crankpin diameters, total weight at the rail under the main drivers, the unsprung weight, the overbalance, the stiffness of the driving spring, and the stiffness of the track considered as an elastic foundation. It is interesting and gratifying to note that the calculated speed at which the driving wheel begins to lift checks very closely with the results observed in the slipping tests. All of the factors in the calculation pertaining to the locomotive are readily available. The stiffness factor, or modulus of elasticity of the track, is not difficult to obtain. A method has been developed by the American Railway Engineering Association which, in effect, gives a factor expressed in essentially the same terms as are used in the measurement of spring stiffness. Essentially, it is the load on the track in pounds per inch of net rail deflection for each inch of rail length.

It is not many years since the field of periodic vibrations in machinery and structures has been brought within the range of mathematical analysis. At about the same time, increasing train speeds began to cause the development of vibratory phenomena, in connection with passenger cars, some of which have been of a very disturbing character. When passenger-train running speeds began to exceed 70 and 80 miles an hour, trucks which were formerly smooth performers began to do snake dances down the track. This has again raised the question of the coned wheel vs. the cylindrical wheel. On light cars the replacement of the former with the latter has corrected the difficulty, indicating that the periodicity of a truck with cylindrical wheels is at least different from that of the same truck with coned wheels. In freight-car trucks the same basic problem has been encountered in connection with helical bolster springs, and a number of devices for damping the tendency toward periodicity at critical speeds have been applied in service. Now, it is clear that somewhat similar phenomena are being encountered with respect to the main drivers when rotating at sufficiently high speeds.

Not only is it encouraging to know that the probable

speed at which such a result may be expected in any given locomotive on a track of known stiffness can be predicted with reasonable accuracy, but also that the problem of designing for high steam locomotive speeds involves no mysterious factors with which we are not already capable of dealing. To deal with it satisfactorily, however, will involve further refinements in methods of counterbalancing. It will also involve the closest attention to the reduction in the weight of reciprocating parts and the lightest overbalance which can be used without causing undue disturbance to the riding of the locomotive.

The paper in question is of such importance that it is being published in full. The concluding instalment will appear next month.

Training the Railway Employees

The railway officer has, as one of his problems, the training of men to fill positions of responsibility. He has to develop the capacity of men, coming from the ranks, so that they are broadened to carry the responsibilities that go hand in hand with the administration of the affairs of which they are to have control. In addition to this, he must meet a condition which is growing rapidly, necessitating a broader training for the men in the ranks. The corporation and its employees have, as a result of the growth and size of organizations, grown apart, and plans through which a better understanding and a more sympathetic feeling can be introduced, seem desirable and necessary.

In the case of the individual there seems to be a demand for a training better and more thorough than that which is the usual course followed by the men coming from the ranks. It frequently happens that a man is selected and put into a position without having had any previous knowledge of such an action on the part of his superiors and with no coaching. He frequently fills the position in which he is placed, broadening the best he can with his own efforts, as he goes along, carrying the responsibilities of his position with all the work attached to it, and with no particular well defined scheme in which he can prepare himself for higher efficiency and greater responsibilities.

Only recently there appeared in one of the railway papers the question: "Why do not young men with a college training remain in the railway service?" This question has often been discussed, and while the railways have retained a large number of college men, it is true that a good many capable men who have obtained a college training have entered the railway service, only to give it up after they have surveyed the field of their future employment. They have realized the odds against which they have to work, and the future in store for them, which is their probable compensation for the years of toil they would have to serve to reach the end. These men have found other lines giving them greater opportunities for development and higher rewards for ability and energy. The man who has not had the opportunity of the college graduate but has the same ambition to do things and develop to his maximum capacity, when he comes from the ranks, has had to accept the handicap where the college man has been able to get away from it.

The opportunity of developing capacity through habit of thought should be given the man long before he leaves the ranks. Judgment develops with practice, it is true, but it is surer when the habit of thought has been directed along the right lines. It is, therefore, a safe plan to pick out the man in the ranks, guiding him possibly long before he is needed for a position of higher responsibility. He should be given an opportunity to adjust his view point while he is still in the ranks. When he finally reaches the first step beyond the ranks and becomes a foreman, a trainmaster or has a position of a similar nature, there is a possibility of developing his capacity beyond what it will be by confining him strictly to his responsibilities and duties, if he is taken into the confidence of his superiors, by being given an insight into the work beyond his daily tasks, or in other words, if he is schooled to have an insight into larger problems that will broaden his usefulness and prepare him for the future.

[The above remarks are especially appropriate today, although first expressed October 21, 1913, over 25 years ago in a paper presented before the Western Railway Club at Chicago. The author was A. R. Kipp, at that time mechanical superintendent of the Soo Line.—Editor]

Progressive Light Repairs

The progressive system, or straight-line method of production originally developed in the automotive industry, was first applied to railway equipment in the construction of new freight cars in the builders' plants. In the course of time, the merits of this system became apparent to railway car-department officers, who also were under heavy pressure to reduce costs, and they said "Why can't we systematize and organize our heavy car-repair work in such a way that it will be divided into a limited number of major repetitive operations, performed one after the other at certain designated spots where men, materials and tools can be concentrated and the work done quickly and efficiently as the cars pass each spot?"

This extension of the progressive system to program car repair work also proved highly successful and netted the railroads many thousands, if not in fact, millions of dollars in the aggregate over the ensuing years. The practicability of the plan hinged, of course, upon balancing the work and the force of men at each position so that approximately the same time element was in-

volved and at a given signal, all the cars in the line could be moved from one position to the next. The advantages of specialized men, efficient tools and the saving of lost motion in handling material, are supplemented by a healthy competition between the gangs at the various positions or spots, all of whom must complete their work within the given time interval or be subject to good-natured joshing by their fellow car men.

In the field of heavy locomotive repair work there was little opportunity for use of the progressive system in most transverse shops, where each locomotive, received for repairs, was placed on a pit track, stripped, unwheeled, overhauled, rewheeled and finished ready for testing in that one position. With the advent of the longitudinal-type shop, however, it proved feasible to strip each locomotive at one point on the incoming center track where it was unwheeled, subsequently moved to a diagonal side pit for complete overhauling, and finally rewheeled at the outgoing end of the center track where all finishing operations were performed. The application of the progressive system to departmental work in all modern locomotive repair shops is, of course, a demonstrated success, the repair of such fundamental parts as driving wheels and boxes, motion work, spring and brake rigging, superheater units, power reverse gears, air-brake equipment, etc., lending itself well to handling on a production basis.

Owing to the widely varying time element in light repair work, it was formerly believed by responsible railway officers that the progressive system offered little opportunity for adaptation in this field of maintenance activity. Even this last stronghold of unorganized, relatively inefficient and "catch as catch can" methods is now being invaded by the carefully planned progressive system, which is now being installed by the Illinois Central, for example, at all major car repair points as described in an article elsewhere in this issue. The major operations, such as jacking cars for wheel changes, repairing trucks, renewing defective couplers and draft gears, repacking journals, cleaning air brakes, repairing leaky roofs, sides and doors, etc., are all performed in orderly sequence by men who specialize in the respective kinds of work and are provided with the tools and materials needed for its efficient handling.

By the location of jacking equipment and necessary hoists at one point where all truck repair work is concentrated and performed as the cars pass this point, it is no longer necessary to move heavy jacks, horses and truck-repair cranes all over the car-repair yard. The location of journal packing and air-brake cleaning are more or less flexible, owing to the relatively light weight of tools required for this work. All steel work which involves the driving of hot rivets, however, it is especially desirable to concentrate as nearly as possible at one point and thus avoid the necessity of moving heavy rivet forges about the yard or using the common, but highly inefficient and unsatisfactory method of heating rivets with the oxy-acetylene torch.

To a certain degree at least, the advantages of the progressive system may seem to be effective in light car-repair work. To what extent will be determined by the progress of this activity on the Illinois Central and other roads which will be watched with interest.

New Books

THE WELDING ENCYCLOPEDIA. *Ninth edition. Published by the Welding Engineer Publishing Co., 608 S. Dearborn street, Chicago. 696 pages, 5⅝ in. by 8¾ in. Price, $5.*

The Welding Encyclopedia is a reference book on metallic arc, carbon arc, oxy-acetylene, electric spot, butt, flash and resistance welding, thermit welding, and metal spraying, presented as a practical treatise to supplement engineering text books and publications currently available. A large part of the ninth edition has been completely rewritten, particularly the sections dealing with arc welding. Subject matter is arranged in alphabetical order, as in a dictionary or telephone book, the need for consulting an index thus being eliminated. In addition to the usual list of trade names, company names have been inserted alphabetically with a full listing of trade names in each case. Although the book contains considerable engineering data, less emphasis has been placed on the purely technical and research aspects of welding for the purpose of making the information of maximum value to the practical man in the shop or out in the firing line in the field.

RAILWAY FUEL & TRAVELING ENGINEERS' PROCEEDINGS. *Published by the association; bound in imitation leather and comprising 268 pages, 6 in. by 9 in. C. Duff Smith, secretary-treasurer, 1255 Old Colony building, Chicago. Price $2.*

This book contains the official Proceedings of the second annual meeting of the Railway Fuel & Traveling Engineers' Association held at the Hotel Sherman, Chicago, September 27 and 28, 1938. In addition to the opening address by President J. C. Lewis, road foreman of engines, Richmond, Fredericksburg & Potomac, the book contains addresses by John Hall, chief inspector, Bureau of Locomotive Inspection; C. F. Richardson, West Kentucky Coal Company and Roy V. Wright, editor, *Railway Mechanical Engineer,* and committee reports on ten subjects pertaining to the more efficient preparation, distribution and use of railway fuel, and four special papers presented by authorities on various phases of the same subjects. The book is logically arranged, clearly printed and easily readable. Individual discussions of the subject matter included in the various committee reports and special papers also present much additional information of importance.

With the Car Foremen and Inspectors

Progressive System of

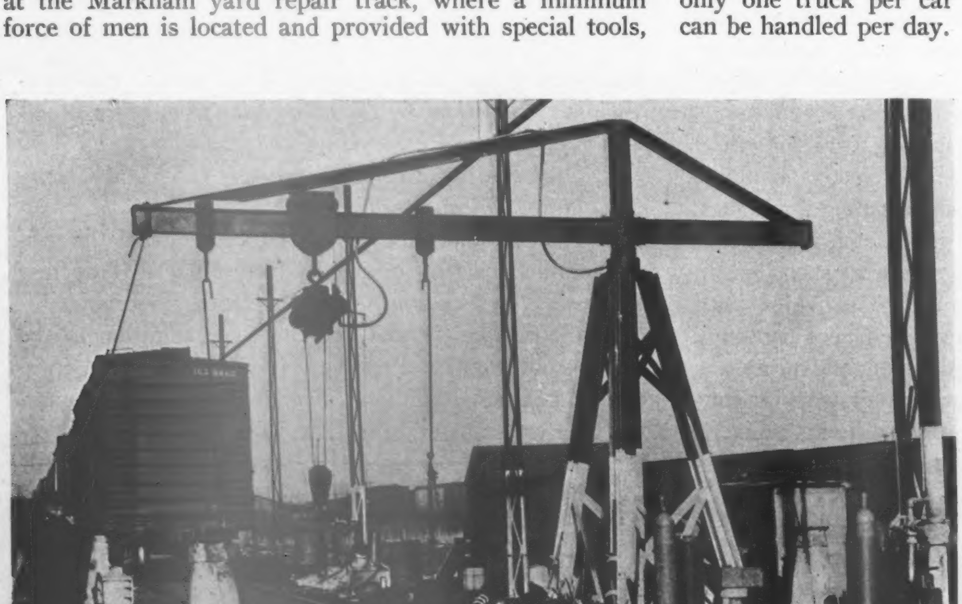
Light Repairs on the I. C.

LIKE many other roads, the Illinois Central has applied successfully the progressive or spot system of freight-car repairs to heavy repair operations at all major points where program work is carried on. This system, modified to a certain extent to suit local conditions, is now being applied with equal success to the work at light-repair tracks where the older method of spotting cars and moving men and repair materials to the cars was formerly employed.

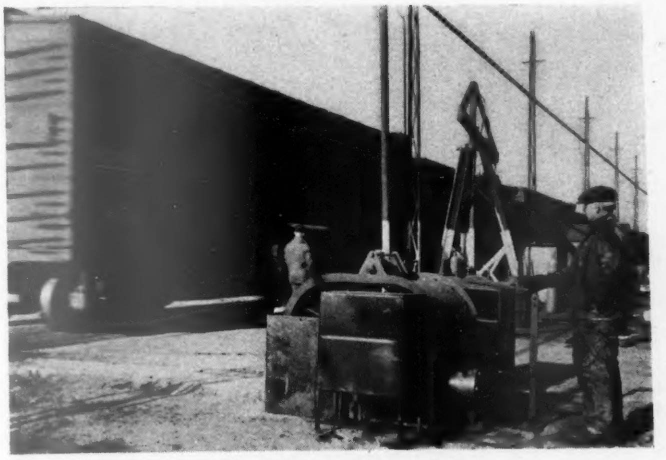
For example, at the I. C. car repair yard at Markham, Ill., an average of 85 bad-order cars a day are classified at the hump and switched to the south end of Track 8 where they are placed without further cutting or spotting, within reach of a power-operated pulling cable. On the average, 32 of these 85 cars a day require truck work, including 16 wheel changes. The balance are sent to the repair track for air-brake work, repacking of journal boxes, renewal of defective couplers or draft gears, and repairing raked siding, leaky doors, roofs and other parts of the car structures.

Both loaded and empty bad order cars are received at the Markham yard repair track, where a minimum force of men is located and provided with special tools, equipment and materials necessary in making all kinds of light repairs. In general, the men are specialists at their respective jobs and each group works at one position on the repair track where necessary tools and materials are provided in advance, and all operations can be performed with minimum delay and also with minimum physical effort by car men, thus tending to assure maximum production per man-hour. Truck work, for instance, which constitutes by far the heaviest part of light repair operations, is concentrated at a single point on the repair track and the cars are therefore, in effect, brought to the repair men, instead of sending the men with their tools and materials to the cars, wherever they may be spotted about the yard. This, of course, is the essence of the progressive system as applied to car repairs.

With a four-man crew, 124 man-minutes or 31 actual minutes per truck is the average time required at the truck repair position, which means that the present capacity of the track is approximately 16 trucks, or 8 cars requiring repairs to both trucks per day. In case only one truck per car is in need of repairs, 16 cars can be handled per day. Any necessary coupler or draft



Car jacking equipment, and swinging crane with hoists used at the truck-repair position at Markham yard



Air-operated hoisting engine and cable, as used in moving cars up to and past the truck repair position

gear replacements are made at this position while the cars are jacked up, and the cars then move north on the repair track where necessary air-brake and other work is done. Cars are pulled twice a day from the north end of the track so that they can be made up in trains and proceed to destination with no more delay than is absolutely necessary.

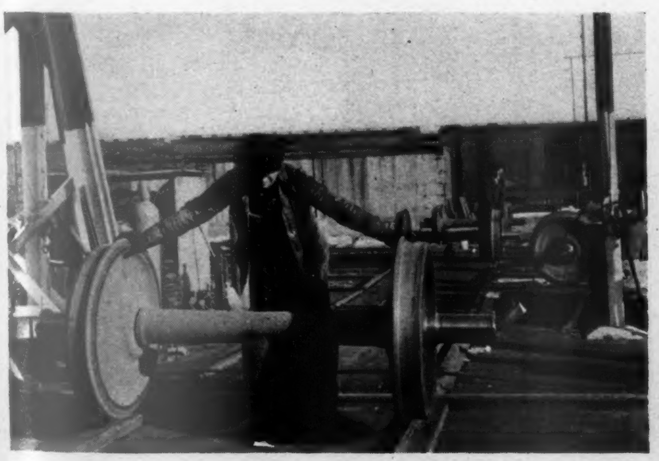
Description of Equipment Used in Truck Repairs

Special equipment supplied at the truck repair position includes four powerful air jacks and four metal horses; a rugged overhead swinging crane, equipped with two Coffing hoists and one Little Giant 2-ton pneumatic hoist for lifting the truck parts; suitable cross tracks and wheel-storage tracks with air-cylinders mounted in the ground at each intersection to permit raising and turning wheels easily without the use of wheels sticks; suitable material storage racks and tool house; and an air-operated hoisting engine, equipped with a 7/8-in. steel cable and hook operating through two 12-in. sheave wheels to pull cars in either direction past the truck-repair position. The main air supply is from a welded 4-in. overhead air line which carries about 100 lb. pressure, and this line, as well as underground cross lines, have been remarkably free from leaks and condensation difficulties since their installation several years ago. During winter months, these air lines are blown out at the conclusion of each day's work to make sure that no moisture will be left in the pipes and cause trouble by freezing.

The most striking feature of the truck-repair equipment at Markham yard is the substantial swinging crane which may be turned parallel with the tracks when not in use or swung out over the truck repair position when needed in dismantling or reassembling trucks. This swinging crane consists of an 8-in. horizontal I-beam, or boom, extending 16 ft. on one side of the vertical supporting member, or mast, and 6 ft. on the other side for use if necessary in lifting heavy materials on the opposite track. The three hoists are supported on rollers and, of course, easily moved to any desired position on the boom. The boom is riveted to the mast at an elevation of 11½ ft. above the ground and the outer ends are supported by 4-in. steel angle braces. The mast, consisting of two 8-in. channels placed back to back and stiffened with steel reinforcing strips welded in place between the flanges, is supported and revolves in a heavy steel tripod structure, also made of 8-in. channels, well braced and mounted on a substantial concrete base.

The weight of the swinging boom and mast is carried on two jack ball bearings, one at the top support and the other at the bottom, thus assuring easy turning of the boom. In accordance with the usual practice the two outer manually operated hoists are used in raising and lowering truck side frames and the center air hoist supports the bolster while the side frames, spring plank, brake beams, etc., are being adjusted to the proper position. The resultant saving in time and labor makes this device a valuable adjunct to the truck repair job.

Possibly not quite as spectacular, but of almost equal importance with the swinging crane, from the point of view of labor saving, is the powerful pneumatic equipment supplied for jacking cars. This equipment consists of four 18-in. passenger-car brake cylinders, located for convenience, one pair on either side of the truck repair position, and arranged so that each pair is operated simultaneously by one air valve, placed conveniently on one of the vertical pipes connected to the 4-in. overhead air line. These air cylinders are permanently mounted on short channel sections which have 24 in. of guided cross travel on rails imbedded in concrete, a construction which permits easily sliding the cylinders out of the way so that they are entirely in the clear when moving a cut of cars over the track. When a car has been jacked up at one or both ends, substantial iron horses 44 in. high and 24 in. in diameter at the base are used to support the weight of the car body while repair work is progressing on the trucks. These iron horses, constructed as shown in the illustrations and resting on concrete foundations, are designed to support heavily loaded cars with a substantial factor of safety.



Cross track along which wheels are moved from the storage tracks to the truck repair position

Lightweight pan which is easily portable and serves effectively to keep journal packing off the ground

Loadmaster and trailers used in handling wheels to and from the car wheel shop

One of the illustrations shows the cross track and air-cylinder wheel-lifting and turning device used in handling car wheels. A wheel-storage area adjacent to the truck-repair position is equipped with four storage tracks having a capacity of 25 pairs of wheels per track. These tracks are all parallel to the main repair track and an 8-in. air cylinder, set in the ground at each intersection, provides full flexibility in moving any desired pair of wheels from one of the storage tracks to the truck-repair position. A short 6-in. pipe section, with a half-cylindrical recess across the top to keep the car axle from rolling off, is not permanently attached to the air-cylinder piston but may be easily removed when necessary so that the piston, in the lowered position, will be flush with the ground and offer no interference to movement of a truck equipped with brake beams and spring plank over the track.

Worn car wheels, removed at the truck-repair position, are taken to the wheel shop for reconditioning by means of a Loadmaster and two trailers, each of which is equipped to carry three pairs of wheels if necessary. The trailers are of the conventional steel-frame type, with wood tops and positioning blocks to keep the car wheels in proper alinement. The Loadmaster is an efficient tool which serves not only as a tractor but is equipped with a boom for lifting various materials which must be handled to and from the repair track. In general, all truck materials such as wheels and axles, bolsters, side frames, spring planks, brake beams, journal boxes, springs, spring seats, etc., are located adjacent to the truck repair position where they can be secured without lost time or the expenditure of much physical effort on the part of the truck-repair men.

Four men are used at the truck-repair position, two on each side, which experience has shown to be an efficient arrangement. Two of the men work on brake beams, brake rigging, etc; the other two are responsible for journal bearings, wedges, springs, spring caps, etc.

A lightweight and unusually satisfactory container or pan for use in repacking a journal box is shown in another of the illustrations. This pan is shallow and made from one end of a paint container which would otherwise be scrapped. A few holes are drilled near the top for insertion of a hook by which to pull the pan over the ground. The use of this device keeps the waste off the ground and hence avoids the possibility of contaminating it with dirt and cinders which increases the difficulty of reclaiming the packing.

Progressive System Used at Other Light Repair Points

The progressive system of working light-repair cars, described in this article, is also used on the Illinois Central at Centralia, Ill., East St. Louis, Ill., Paducah, Ky., Memphis, Tenn., and McComb, Miss., and at present the system is being installed at Louisville, Ky., Birmingham, Ala., and Council Bluffs, Iowa.

The method at some of these points varies in certain details. For example, in some instances, there is a wheel-loading track alongside of the truck-repair position, which permits loading wheels without the use of a Loadmaster or tractor service, and this results in some saving of cost.

At several of the points, from two to four tracks are used for truck repairs, the positions being parallel on all tracks. Some arrangement of this sort will also be installed at Markham in the near future, owing to the fact that occasionally more cars are received requiring wheel changes than can readily be handled at one position.

The rigidly constructed swinging crane and hoist equipment in use during the dismantling of a truck

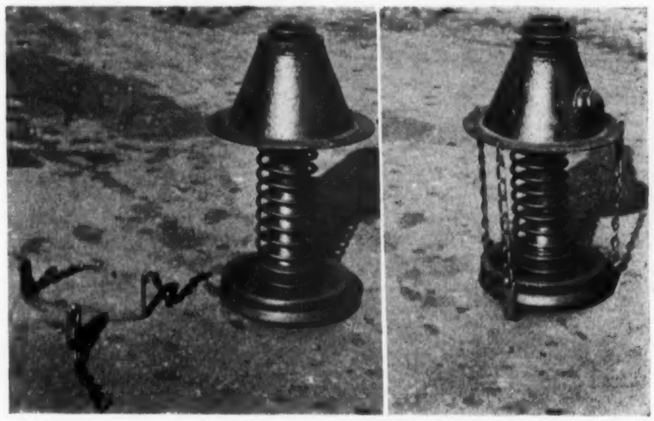
Two Air Brake Devices

Two relatively simple devices for expediting air-brake repair work at the Dupo, Ill., car shops of the Missouri Pacific are shown in the illustrations. The first view illustrates a device designed to hold the non-pressure head of a Type AB brake cylinder against spring pressure while the collar is being removed when necessary to remove the non-pressure head for any reason. The device consists simply of a circular steel base piece to which are welded three small angles made of ¼-in. by 1-in. steel, with the upper ends forged to an eye-shape for connection to short pieces of fire-door chain. The upper link of each chain is opened to form a hook, as shown at the left. This bracket is placed on the ground and the piston set in the bracket in such a way that the non-pressure head can be pushed down about one inch and held in place against spring pressure by attachment of

Triple-valve storage rack and a pneumatic device for cleaning triple-valve gasket faces

the hooks, as illustrated at the right. The piston collar and the three bronze rings can then be readily removed in case they need replacement. If other work necessitates, the three chains can then be unhooked and the entire piston, push rod, spring and non-pressure head disconnected.

A convenient triple-valve rack and a quick and sure method of cleaning triple-valve faces so that there is practically no chance of their leaking when reapplied with new gaskets is shown in the second illustration. This triple-valve facing device consists of a 6-in. square block of wood 1½ in. thick which is bored and equipped with a 3-in. steel bushing to fit down over the triple-valve center boss. This block, equipped with two No. 50 grit emery-cloth strips, 2½ in. wide, on the lower surface, is supported and hinged in a steel bracket made of ⅜-in. by 1½-in. stock, braced with a small tie rod at the center and having a welded taper spindle at the top which engages the shank of a small air motor. A few turns of this motor under such small pressure as may be necessary, suffices to clean the face of the triple valve thoroughly of rust, dirt and any small pieces of gasket



Angle bracket and chain arrangement used in removing the non-pressure head of a Type AB brake cylinder

rubber which may adhere to it, thus assuring a tight job when the triple valve is reapplied with a new gasket.

The triple-valve face could, of course, be cleaned by hand at the bench using an ordinary piece of emery cloth but this would take more time and, in fact, be a less satisfactory job than can be obtained with the simple device illustrated.

Questions and Answers On the AB Brake

Miscellaneous

374—*Q.—What is the weight of the complete AB equipment?* A.—585 lb.

375—*Q.—What is the weight of the service portion?* A.—51 lb.

376—*Q.—What is the weight of the emergency portion?* A.—52½ lb.

377—*Q.—What is the weight of the mounting bracket?* A.—68 lb.

378—*Q.—What is the weight of the brake cylinder?* A.—169 lb. with lever bracket; 157½ lb. with the plain pressure head.

379—*Q.—What is the weight of the combined auxiliary and emergency reservoir?* A.—255 lb.

380—*Q.—What is the weight of the separate emergency reservoir?* A.—Approximately 160 lb.

381—*Q.—What is the minimum brake-cylinder pressure obtainable with a brake application in a solid AB train?* A.—10 lb.

382—*Q.—What is meant by the expression: "Transmission rate in feet per second?"* A.—The length of the main brake pipe between the front and the rear cars is divided by the number of seconds between the outward movement of the brake-cylinder piston on the front and the rear car, the result being so many feet per second.

383—*Q.—Does the transmission rate change in proportion to the length of the brake pipe?* A.—The emergency transmission rate is practically the same, but the

service transmission rate changes with the length of the train, the length of the brake pipe, etc., to some extent.

384—*Q.—Based upon rack data, what is the service transmission rate?* A.—Approximately 475 ft. per sec.

385—*Q.—How does this compare with the K equipment?* A.—With the K equipment the rate is approximately 90 ft. per sec. with brake-pipe leakage, and varies materially with the length of the train and the brake-pipe leakage.

386—*Q.—What is the brake release time from 50 to 5 lb.?* A.—22 sec.

387—*Q.—How does this compare with the K equipment?* A.—Normal release with the K equipment is 6 sec., and retarded release is 22 sec.

388—*Q.—What is the necessary range in differential to accomplish service release?* A.—1 to 1.5 lb.

389—*Q.—How does this compare with the K equipment?* A.—The range for the K equipment is 1 to 5 lb.

390—*Q.—What is the emergency transmission rate for a 150 car W.A.B. rack?* A.—Approximately 950 ft. per sec.

391—*Q.—What is the rate for the K equipment?* A.—Approximately 625 ft. per sec.

392—*Q.—What brake-cylinder pressure is developed in emergency from a 70 lb. charge?* A.—60 lb.

393—*Q.—What brake-cylinder pressure is developed in emergency from a 70-lb charge with the K equipment?* A.—55 to 56 lb.

394—*Q.—What is the limit of service reduction, following which emergency action can be secured?* A.—No limit with the AB brake. With K equipment it is approximately 8 lb. from 70 lb.

395—*Q.—What is the brake-pipe pressure following an emergency?* A.—Zero with the AB brake; with K equipment it is 42 lb. if the brake valve is lapped promptly.

396—*Q.—What is the blow-down time of the quick-action chamber?* A.—70 sec.

397—*Q.—To what pressure does the brake cylinder and the auxiliary reservoir fall during accelerated emergency release following an emergency application from a 70 lb. charge?* A.—It averages about 48 lb.

398—*Q.—Does this always prevail?* A.—No. This figure will vary with different combinations of AB and K equipment.

399—*Q.—What pressure is required in the brake pipe before the accelerated release functions?* A.—About 23 lb.

400—*Q.—Why is this figure established?* A.—In certain mixed combinations of AB and K equipment, the AB vent valves may not reduce the brake-pipe pressure throughout the train below 20 lb. For this reason, and in order to prevent undesired partial release of the AB brakes, this value is used.

401—*Q.—What is the comparative diameters of the service pistons?* A.—In the AB equipment it is 4 in., while in the K equipment it is 3½ in.

402—*Q.—What is the volume of the quick-service bulb?* A.—30 cu. in.

403—*Q.—What is the volume of the quick-action chamber?* A.—160 cu. in.

404—*Q.—How do the feed grooves compare as to capacity?* A.—The orifice capacity is about the same for the AB and the K valves.

405—*Q.—What is the charging time for a completely depleted equipment to 70 lb. when cutting single equipment into a charged train?* A.— 7 min. with the AB equipment and 3 min. with the K equipment.

406—*Q.—How does the recharge time compare?* A.—Practically the same for both types of equipment.

407—*Q.—What is the comparative blow-down time of the auxiliary reservoir?* A.—Approximately 6 sec. with the AB equipment and approximately 3 sec. with the K equipment.

408—*Q.—What units of the AB equipment are interchangeable with the K equipment?* A.—For new equipment, the retaining valve and angle cock are interchangeable; and for conversion, the auxiliary reservoir, brake cylinder (modified) and combination dirt collector and cut-out cock are interchangeable.

409—*Q.—With a fully charged system of 150 cars each 50 ft. long, how many cut-out equipments will a solid train of AB valves jump in emergency?* A.—8 near the center of the train and from 3 to 5 elsewhere.

Copper Tubing for Air Brake Piping

Among the recently introduced products of the Chase Brass & Copper Company, Waterbury, Conn., are seamless copper tubing and accessory fittings for use as air-brake piping. This development is the result of several years of experimental work on hopper cars in the service of the Utah Copper Company. In addition to 300 cars of this company on which copper tubing is now in active service there is one gondola car on an eastern railroad on which copper tubing was installed in 1935.

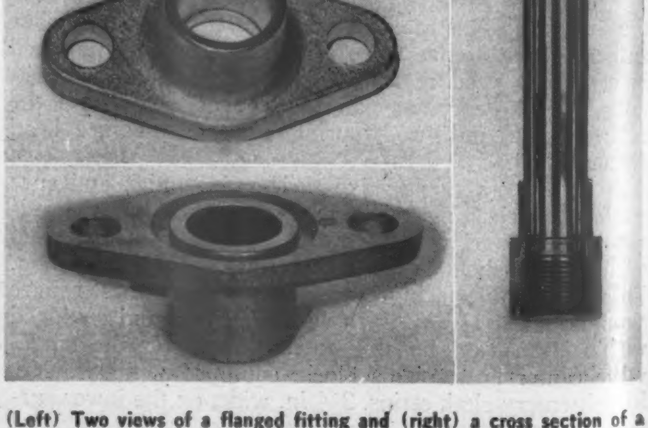
Among the advantages claimed for the use of copper tubing in air-brake service are: (1) Freedom from rust and scale; (2) decreased friction loss; (3) freedom from leakage at soldered joints; (4) saving in weight and (5) practically equal cost of copper tubing and fittings in comparison with iron pipe and fittings.

The copper tubing is made of 99.9 per cent pure copper in seamless form and is supplied in 20-ft. straight lengths, half-hard temper. The accompanying table shows the bursting pressure and breaking load of four sizes of half-hard-temper tubing.

Outside diameter, in.	Wall thickness, in.	Bursting pressure, lb. per sq. in.	Braking load (based on 45,000 lb. tensile strength)
0.500	.035	6,000	2,250
0.875	.045	4,500	5,300
1.125	.050	3,800	7,550
1.407	.065	4,400	12,250

A complete line of wrought copper fittings is available and also a full line of cast bronze fittings consisting of 85 per cent copper, 5 per cent tin, 5 per cent lead and 5 per cent zinc and certain special wrought fittings are made from commercial bronze rod.

The joints between fittings and tubing are soldered



(Left) Two views of a flanged fitting and (right) a cross section of a threaded fitting soldered to copper tubing

with a special solder composed of 95 per cent tin and 5 per cent antimony which has a melting point of 465 deg. F. The process of soldering the joint is quite simple. After tubing and fitting have been thoroughly cleaned and soldering flux applied, the joint is heated evenly by means of a torch. When the proper temperature has been reached the flame is removed and the solder fed into the joint. The surplus solder is brushed off and the joint is finished. Five years of tests have indicated that this type of joint is adequately strong and is resistant to vibration and to creep. It has been used on practically all Diesel-powered streamline trains.

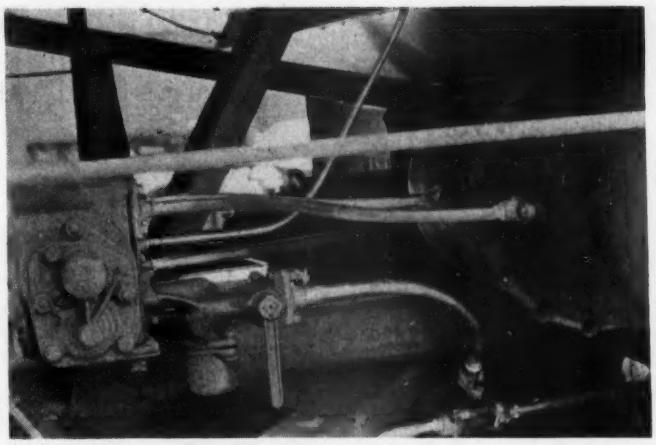
The quantities and sizes of the tubing and fittings used on one of the Utah Copper Company's ore cars, previously mentioned, appear in an accompanying table.

Tubing and Fittings Used on U. C. C. Ore Cars

Location	No. ft. used	O. D., in.	Wall thickness, in.
Main brake pipe	33	1.407	.065
Branch pipe	2	1.125	.050
Emergency and auxiliary reservoir and brake cylinder	15	0.875	.045
Retainer pipe	20	0.500	.035

4—1.250-in. SPS* extra heavy nipples, threaded one end with other end bored to fit 1.407-in. tubing
2—1.250-in. standard threaded reinforced-flange fittings
4—1.407-in. sweat flange fittings
2—1.125-in. sweat flange fittings
6—0.875-in. sweat flange fittings
1—0.500-in. sweat flange fittings
1—1.407-in. copper-to-copper coupling
1—0.500-in. copper-to-copper coupling
1—0.500-in. copper-to-copper elbow
1—0.500-in. SPS-to-copper adapter

* SPS—standard pipe size.

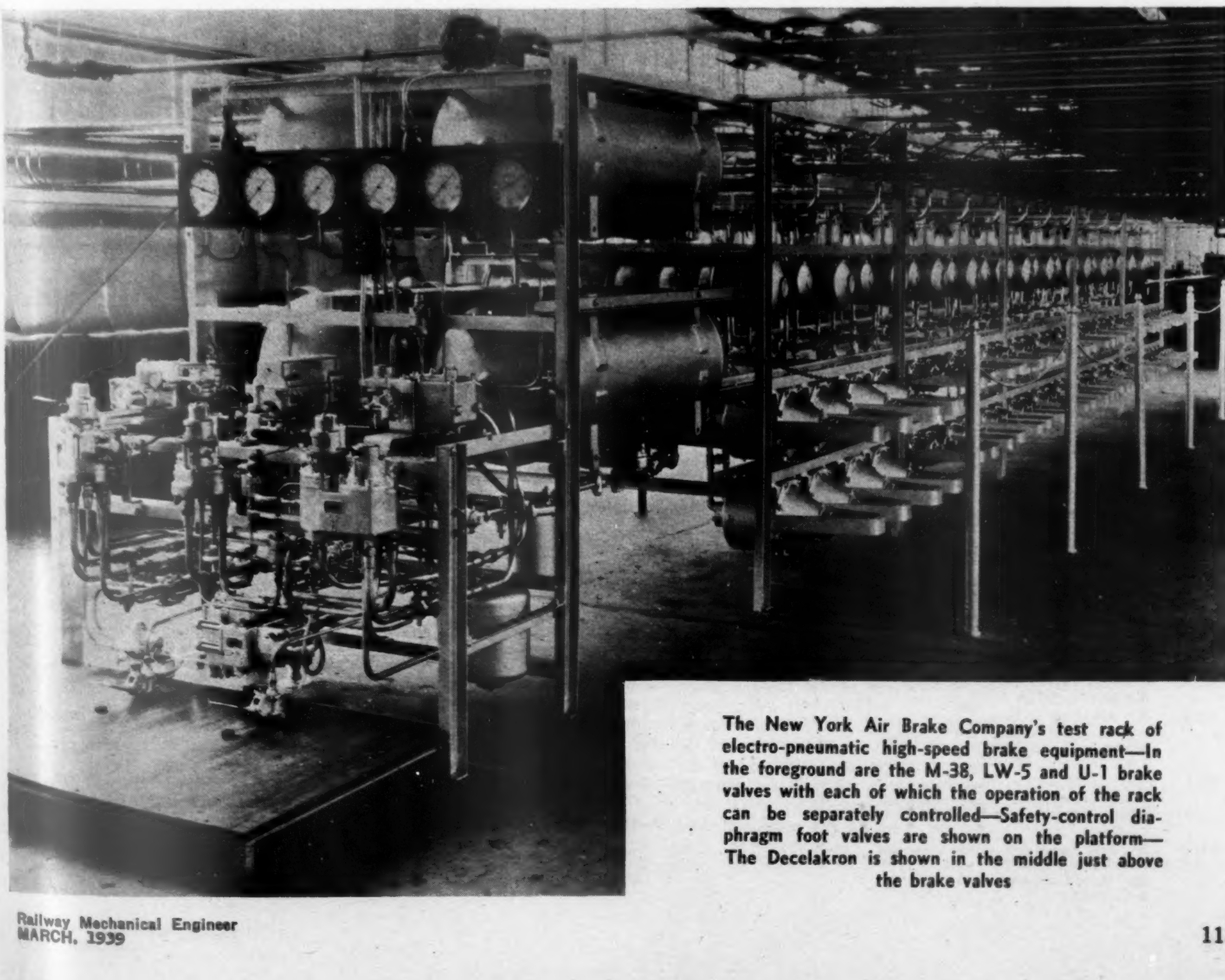


Hopper car air brake piping in which copper tubing and fittings have been used

The weight of the copper tubing used on the Utah Copper Company ore cars is 45 lb. The equivalent quantity of extra-heavy iron or steel pipe would be approximately 136 lb.

The manufacturer of the tubing and fittings has developed the line of fittings in accordance with the recommendations of the air-brake manufacturers so that the fittings are interchangeable in the event of a breakdown. Repairs to the pipe lines of cars equipped with the copper tube and fittings can thereby be made at any car shop by merely substituting iron or steel pipe and the standard reinforced flanged fitting for the copper tube or the sweat flanged fitting.

* * *



The New York Air Brake Company's test rack of electro-pneumatic high-speed brake equipment—In the foreground are the M-38, LW-5 and U-1 brake valves with each of which the operation of the rack can be separately controlled—Safety-control diaphragm foot valves are shown on the platform—The Decelakron is shown in the middle just above the brake valves

IN THE BACK SHOP AND ENGINEHOUSE

One of the J. & L. turret lathes working on boiler studs

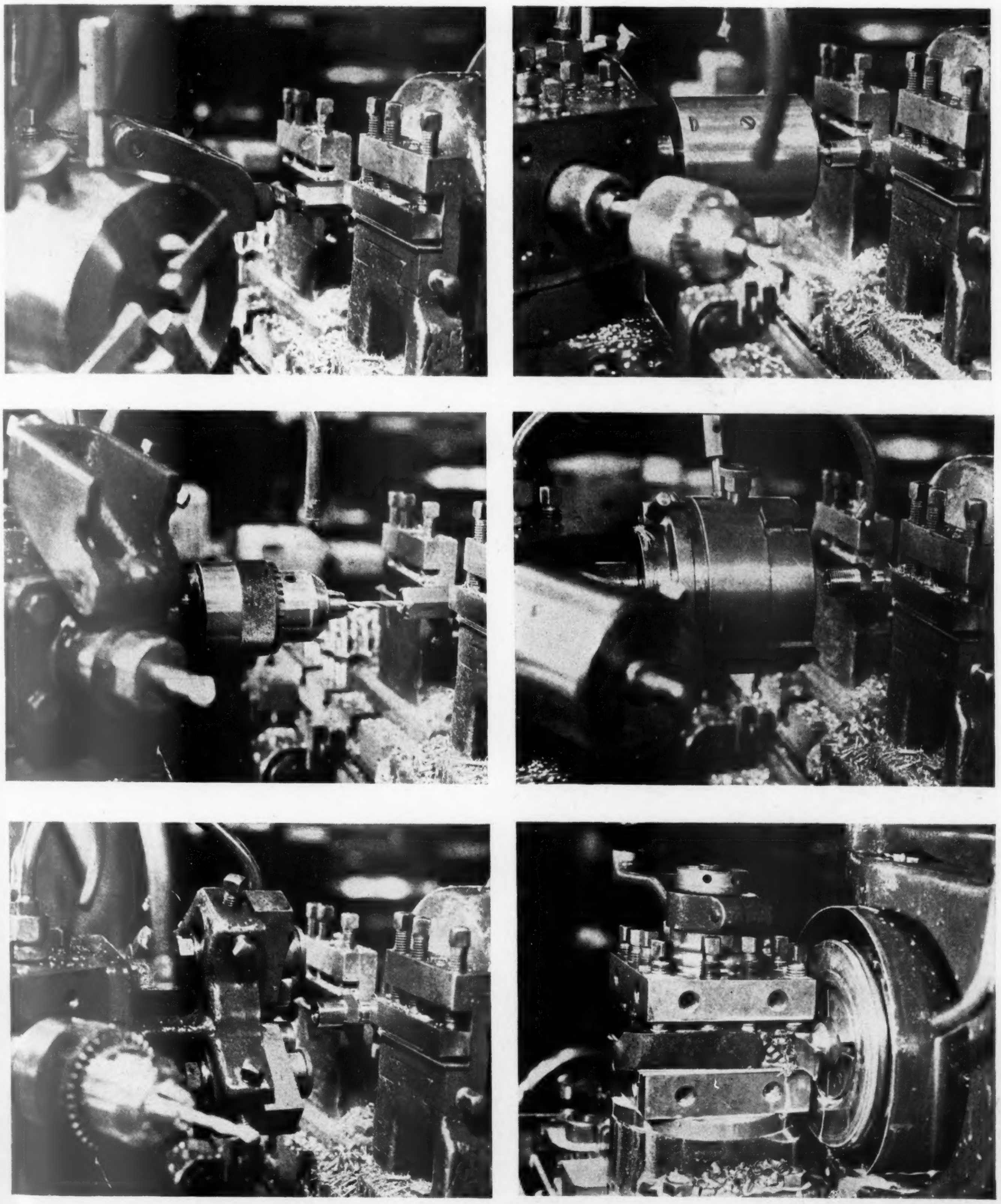
Lehigh Valley Modernizes Turret Lathe Department

Prior to the installation of the present group of modern machines in the turret lathe department at the system shop of the Lehigh Valley at Sayre, Pa., the entire output of such parts as are ordinarily made on this type of machine was produced on a group of 11 turret lathes having an average age of 30 years and varying in age from a minimum of 17 to a maximum of 39 years; 8 of these 11 machines were belt driven, the remaining 3 having direct and independent motor drives.

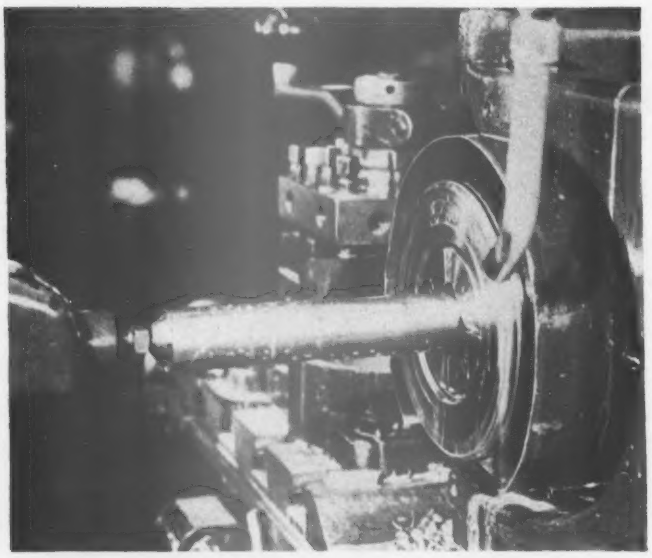
During 1936 it became evident to the shop management that these older machines were not capable of maintaining the desired output at a satisfactory cost. A complete study was made of all of the operations involved in the turret lathe group and, as a result, the 11 old machines were retired and replaced with five new Jones & Lamson turret lathes, the last of which was installed in November, 1937. In spite of the fact that these shops have not been operated at maximum capacity at any time since these new machines were installed, the savings which have been made are such as to justify the cost of installation. The performance of this group of machines so far on quantities of work limited by curtailed production have indicated production increases averaging 150 per cent for the entire group as compared

Table I — New Turret Lathes Installed and Machines Replaced in Sayre Shop

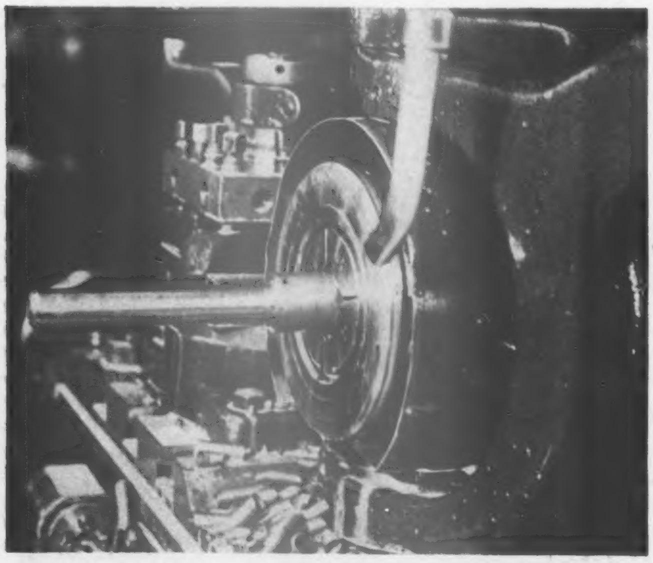
	New Machines			Machines replaced					
Shop No.	Type of Machine	Date installed	Work group	Shop No.	Type of machine	Date installed	Age, yrs.	Type of Drive	Type of work
1454	4-in. Jones & Lamson cross-sliding head flat turret lathe	8-12-37	A	238	5½-in. Gisholt	1903	34	Belt	Pins and bushings
				227	4½-in. Gisholt	1901	36	Belt	Bushings
				237	7-in. Gisholt	1910	27	Motor	Pins and bushings, oversize
				228	6-in. Steinle	1911	26	Motor	Large pins and bushings
1455	1½-in. x 10-in. Jones & Lamson plain ram-type turret lathe. Spindle speeds, 30 to 1,500 r.p.m.	8-12-37	B	226	No. 4 Warner & Swasey	1898	39	Belt	Boiler studs
				235	No. 6 Warner & Swasey	1898	39	Belt	Studs
1456	No. 8D, 3-in. x 36-in. Jones & Lamson universal saddle-type fixed-head turret lathe. Spindle speeds, 20 to 1,000 r.p.m.	10-4-37	C	231	3-in. x 36-in Jones & Lamson	1911	26	Belt	Brake and spring equalizer pins
				234	3-in. x 36-in. Warner & Swasey	1905	32	Belt	Brake and spring equalizer pins
1457	No. 3, 1½-in. x 10-in. Jones & Lamson universal ram-type turret lathe. Spindle speeds 30 to 1,500 r.p.m.	10-18-37	D	233	No. 4 Warner & Swasey	1920	17	Belt	Small valves and pins and small brass work
1464	No. 8A, Jones & Lamson universal turret lathe with bar outfit including thread chasing and taper attachments	11-30-37	E	232	No. 2A Warner & Swasey	1914	23	Motor	Pins and bushings
				236	2½-in. x 24-in. Jones & Lamson	1905	32	Belt	Pins, general use



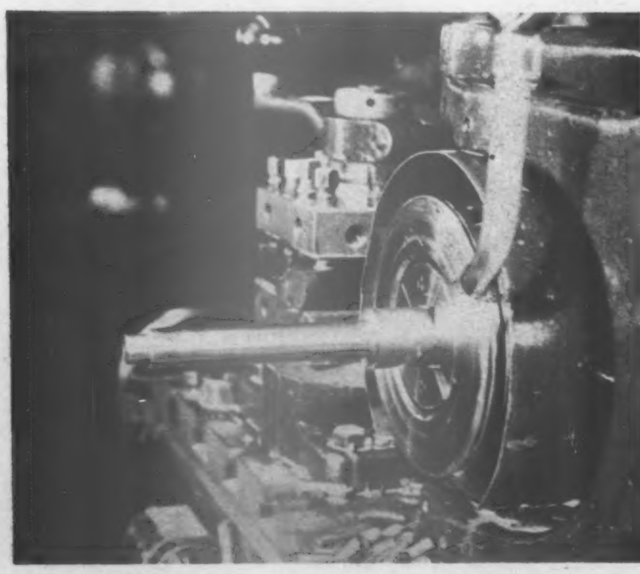
Upper left—the first step in the manufacture of a brass driving box lubricator connection is to bring the stock to length against the stop; center left—here the end of the stock has been countersunk and is now being drilled 7/32-in. diameter through the piece; lower left—the outside of the large end has been turned with a roller tool; upper right—this is operation No. 6 which consists of tapping the end with 1/8-in. pipe tap; center right—Operation No. 7 is the cutting of the 1/2-in. pipe thread on the outside of the large end of the fitting; lower right—the end of the first chucking—the semi-finished piece has been cut off from the bar



Guide brace bolt—Operation No. 1



Operation No. 2—Turning the body



Operation No. 3—Turning the small end

Table II—Work Group A—Machine No. 1454

Bushings made from tubing or round bar:

Diameter, in.		Length, in.	
Outside	Inside	Minimum	Maximum
1⅜	⅞	1¼	2¾
1½	1	¾	3½
1½	1	1	3
1½	1⅛	1	3½
1⅝	1⅛	1	4
1⅝	1¼	¾	3½
1¾	1⅜	1	3½
1⅞	1⅜	1	4
1⅞	1½	1	4
1⅞	1½	¾	2
2	1½	1	4¼
2	1¾	1	4
2⅛	1⅜	1	4
2⅛	1½	1⅝	3½
2⅛	1 9/16	2	4¼
2⅛	1¾	1	4½
2⅛	1⅞	1	4
2¼	1 9/16	1¾	4
2¼	1 11/16	1⅞	4¼
2¼	1¾	1¼	3½
2¼	1⅞	1¾	4½
2¼	2	1½	4½
2⅜	2	1¼	4½
2⅜	2⅛	2	3½
2⅜	2¼	1	4
2½	2	1½	4
2½	2⅛	2	4
2¾	2	1¼	3
2¾	2¼	1¾	4½
2⅞	2	1½	3½
3	2½	1¼	4½
3 1/16	2 9/16	1 13/16	3½
3⅛	2½	1½	4½
3¼	2¾	1⅝	4
3⅜	2½	1¾	4
3½	2½	1¾	4½
3½	3	2	4
3⅝	3¼	1⅞	4½
3¾	3	3	5
3¾	3¼	3	5
3⅞	3⅜	3	4¼
4	3½	2	4½
4¼	3¾	2	4½
4¼	3¾	3	7
4⅜	3¼	2	4½
4⅜	3⅞	3	5

Note: Special sizes are turned on shop order. Approximately 130 of the above sizes may be machined per day from tubing and 40 from round bar stock.

Table III—Work Group B—Machine No. 1455

The following sizes of boiler studs are machined:

Diameter, in.		Length, in.	
Boiler end	Standard end	Minimum	Maximum, average
⅝	⅝	2	10
21/32	⅝	2	10
11/16	⅝	2	10
23/32	⅝	2	10
¾	¾	2	12
13/16	¾	2	12
25/32	¾	2	12
27/32	¾	2	12
⅞	⅞	2½	12
29/32	⅞	2½	12
15/16	⅞	2½	12
31/32	⅞	2½	12
1	1	3	12
1 1/32	1	3	12
1 1/16	1	3	12
1 3/32	1	3	12
1⅛	1⅛	3	12
1 5/32	1⅛	3	12
1 3/16	1⅛	3¼	12
1 7/32	1⅛	3¼	12
1¼	1¼	3¼	12

An average of 350 of any of the above size studs can be machined daily.

with the 11 machines which were replaced. Actual savings have run as high as $700 a month, a decidedly satisfactory return on a total investment in machines, tooling equipment and installation costs totaling somewhat less than $25,000.

With the exception of certain small parts manufactured on two automatic screw machines and a small group of portable lathes located in the erecting shop which specialize on tapered bolts, these five machines take care of all the major requirements of such parts as are indicated for the entire Lehigh Valley system. Table I shows the general specifications and date of installation of the five new machines. Opposite each of the new machines shown in the table are the data relating to the older machines which were replaced by that machine. The general type of work performed on each new machine is also shown in this table and the details of parts and sizes are shown in Tables II to VI, inclusive.

Typical Parts Operations

The illustrations show two typical sets of operations on these new machines. One group of pictures shows the several steps in the finishing of a driving-box force-feed lubricator connection. These brass connections are made in two chuckings, as follows:

Table IV—Work Group C—Machine No. 1456

Pins made from bar iron and steel.

Diameter, in. Stock	Diameter, in. Body	Length, in Minimum	Length, in Minimum
1½	1	3	5½
1⅝	1 3/32	4	6½
2	1¼	3½	9
2	1 7/32	3¼	5½
2	1⅜	4	7½
2	1 9/32	4	6
2	1 11/32	4	6½
2	31/32	3½	7
2	1 11/16	3½	6½
2	1½	4	9
2¼	1¾	4	10
2¼	1⅞	4½	10½
2¼	1 15/16	4¾	7
2¼	1 11/32	3¼	7½
2¼	1 27/32	7½	9 13/16
2½	2	4	10⅝
2½	1 23/32	4⅜	10
2½	1⅞	4¼	7
2½	1 15/16	4½	7½
2⅝	2⅛	4½	11
2⅝	2¼	4½	11⅞
2¾	2⅜	6	9
2¾	2¼	5½	9
2¾	2	5	9
2¾	2⅜	5	8½
2¾	1 31/32	4¾	6½
3	2	6	10½
3	2¼	4	7
3	2⅜	4½	9
3	2⅛	5½	10½
3	2 5/16	5	9
3	2½	5	8½

Other special size pins and bushings are turned on this machine. Approximately 45 of any of the above sizes may be machined per day.

First Chucking

Operation No. 1—Bring stock to stop for length; face and chamfer the end
Operation No. 2—Countersink the end
Operation No. 3—Drill 7/32-in. hole through entire length and turn the back end of the piece while the drilling is being done
Operation No. 4—Turn the front end to size for cutting threads
Operation No. 5—Drill front end to required depth with 13/32-in. drill
Operation No. 6—Tap front end with ⅛-in. pipe tap
Operation No. 7—Thread outside diameter of front end with ½-in. pipe thread
Operation No. 8—Cut off semi-finished piece from bar stock

Second Chucking

Operation No. 1—Drill the rear end—13/32-in. drill, ⅜ in. deep
Operation No. 2—Thread the rear end ¾ in. 13 threads
Operation No. 3—Countersink the rear end for valve seat with 11/16-in. drill

Table V—Work Group D—Machine No. 1457

Small pins and bolts from ¼ in. to 1¼ in., not over 9 in. long
Studs of all sizes up to 1½ in., not over 9 in. long
Set bolts all sizes up to 1¼ in., not over 9 in. long
Set screws all sizes up to 1¼ in., not over 9 in. long
Hose nipples, ⅞ in. x 3 in.
Lubricator work—pins and bolts, ⅞ in. x 4 in.
Lubricator work taper pins, ½ in., ⅝ in. and ¾ in. x 2½ in.
Brass driving box connection, ¾ in. x 2 in.
Brass guide fittings, ¾ in. x 2½ in.
Brass nipples not to exceed 1½ in.
Copper collars—button-head up to 1½ in. diameter
Any other copper work up to 1½ in. diameter
Approximately 70 of any of the above sizes may be machined per day.

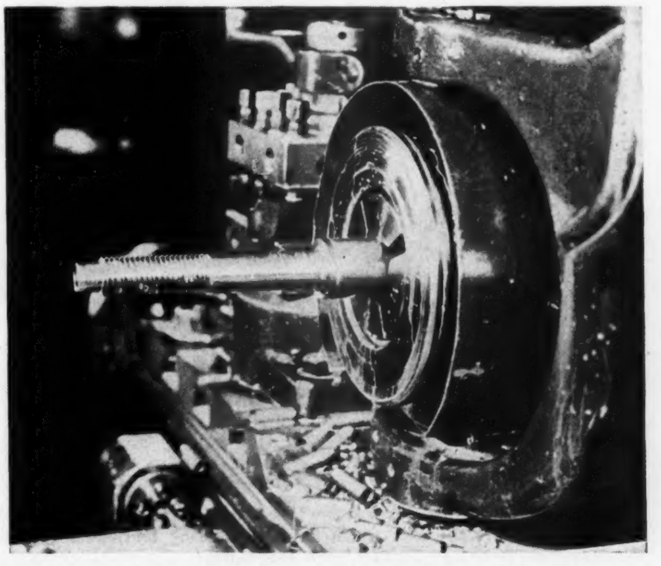
The operation time for the first chucking is 65 seconds and for the second chucking 18 seconds, making a total time for each piece of 1 min. 23 seconds.

The other group of illustrations shows the several steps in the machining of a guide brace bolt which is made from open-hearth bar stock 1⅜ in. in diameter. The details of the operations and the time follow:

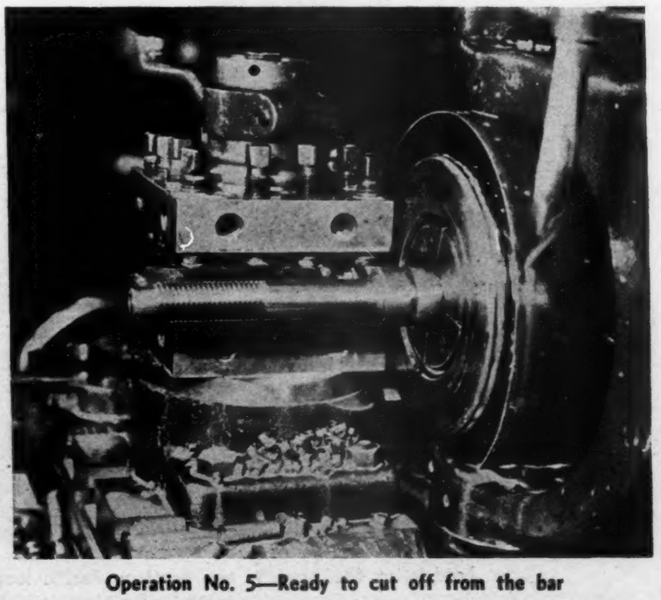
Operation No. 1—Bring stock to length, face end and chamfer. Speed, 340 r.p.m., time, 25 sec.
Operation No. 2—Turn the body of the bolt. Speed, 243 r.p.m., time, 80 sec.
Operation No. 3—Turn the small end of the bolt. Speed, 243 r.p.m., time, 20 sec.
Operation No. 4—Cut the threads on the bolt. Speed, 42 r.p.m., time, 32 sec.
Operation No. 5—Cut off. Speed, 340 r.p.m., time, 50 sec.
Total time—3 min. 27 sec.

Table VI—Work Group E—Machine No. 1464

Stay-plate bolts, 1⅜ in. x 5½ in. from 1¾ in. hex steel
Spring-rigging bolts, 1¾ in. x 7 in. x 9 in.—10 in. from 2½ in. rolled steel
Brake-rigging bolts, 1¼ in. up to 1¾ in. from 4 in. to 10 in. long
Tapered plugs for driving boxes, ⅞ in. x 2 in., 1 in. x 2 in.
Patch bolts, from 1 1/16 in. to 1 15/16 in. x 3 in. long
Boiler plugs, 1 in. to 2 in. x 1½ in. long
Grease plugs for driving rods, 1⅞ in. x 3 in. long
Grease plugs for driving rods, 2½ in. x 3 in. long
Motion-work pins, 2 in. x 6 in.
Bolts for electrical department, 2 in. x 16 in.
Pins and nipples, etc., up to 3 in. diameter
Approximately 40 of any of the above sizes may be machined per day.



Guide brace bolt, Operation No. 4—the threads have been cut on the body of the bolt



Operation No. 5—Ready to cut off from the bar

Locomotive Driving Journals Are Oil Lubricated

Designed to minimize locomotive failures due to hot driving boxes, a system of oil lubrication for driving journals and hubs has been developed by the motive power department of the Southern Pacific and installed on two 4-8-2 type locomotives, one of which, No. 4340, is shown in the illustration. Two other locomotives are now being equipped.

The new system substitutes oil for the conventional grease in driving boxes, eliminates hand lubrication of driving wheel hubs and minimizes the scoring of journals. Journal temperatures under operating conditions are reduced by more than 100 degrees.

The system, in part, comprises the use of spring-supported lubricating pads, heretofore used only in modern passenger car, engine and trailer trucks. The use of these spring lubricator pads on driving boxes entails only a minor change in the conventional grease cellars to provide for a cellar from which oil is drawn up by wicking into a pad in constant wiping contact with the journal.

Supplementing the spring pads in the new driving box lubricating system, as a further guarantee against lubrication failure, oil from the locomotive's mechanical lubricator is constantly fed through tubes into the crown bearings.

To improve the lubrication and wearing properties of the brass crown bearings, a serrated recess in each brass is filled with white metal as a bearing surface. This white metal has the characteristic of maintaining an even distribution of oil over its surface, and it is soft enough so that the scoring of journals is substantially minimized should the bearings become overheated for any reason.

Tests of locomotives equipped with the improved oil-lubricating system are said to show remarkably low journal temperatures under all operating conditions. Pyrocon readings on the surface of the journals have indicated temperatures, as low as 70 deg. F. and only as high as 130 deg. F. Under the same conditions conventional brass crown bearings, grease lubricated, are said to average between 200 and 350 deg. F.

The system also provides positive automatic lubrica-

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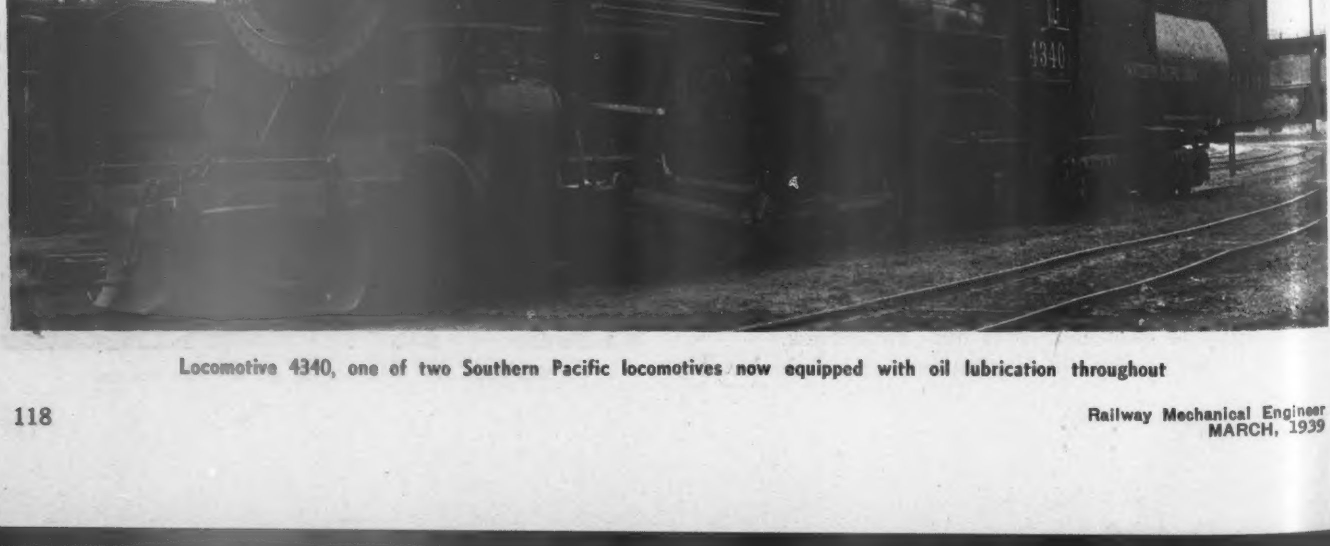
Driving box spring pad lubricator—The wicking draws up oil from the cellar to saturate the pad, which is held by spring tension in constant contact with the journal

Felt pads on the oil cellar lubricate the hub—Coil spring mountings on the latches permit free lateral motion on driving-box spacers when the wheel hubs come in contact with the pads



Locomotive 4340, one of two Southern Pacific locomotives now equipped with oil lubrication throughout

Driving box oil-cellar assembly with water guard in place

tion of driver hubs by means of two hard felt pads inserted in slots at the rear of the oil cellar. These pads project 1/8 in. beyond the babbitted face of the box and at the inner ends are fed from the cellar through small holes.

Cellars are held in place by latches fitted with coil springs to permit free endwise movement of the cellars when the wheel hubs come in contact with the felt pads due to lateral motion. The cellars are easily withdrawn without removing cellar bolts as was formerly necessary.

Heretofore it required one man about 80 minutes to repack the conventional grease cellars in eight driving boxes of a mountain-type locomotive, whereas filling the eight oil cellars may be accomplished in ten minutes with consequent reduction in the cost of lubrication, both labor and material. A glass bull's eye sight on the cellar shows the exact oil level.

The two Southern Pacific locomotives on which the new system has been installed are now 100 per cent oil lubricated. Trailer- and tender-truck journals are lubricated by spring pad lubricators, and driving boxes and engine journals are lubricated by spring pad lubricators and the mechanical lubricator. The mechanical lubricator also provides lubrication for shoes and wedges.

The cost of lubricant for all journals, hubs, shoes and wedges on each of these locomotives is said to be only about $1.75 per 1,000 locomotive miles.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Efficiency of Patches at Boiler-Check Holes

Q.—In applying a reinforcement patch at the boiler check, should the patch applied be the same thickness as the shell course or may thinner material be used?—C. S. B.

A.—The efficiency of any boiler patch applied to the shell of a boiler should be at least equal to the efficiency of the longitudinal seam of the boiler shell course to which it is applied.

It is not necessary that the thickness of the patch be the same as the thickness of the boiler shell course to which it is applied, provided the efficiency of the patch is at least equal to the efficiency of the longitudinal seam. However, it is good practice to make the patch the same thickness as the shell course, because the efficiency of a well-designed diamond-shaped patch is usually obtained along the outside diagonal row of rivets. This efficiency would also be the efficiency of the shell course along this row of rivets, and for this reason the allowable working pressure on the patch, based on the efficiency along the diagonal row of rivets, would also apply to the shell course provided the thickness of the patch and the shell course were the same.

Where is the Breaking Zone of a Firebox?

Q.—Where is the breaking zone of a firebox, or where would you consider the bolts most likely to break?—S. A. W.

A.—The staybolt breaking zone in a firebox is generally accepted as being as follows: (1) In the throat at the two outermost rows on the sides, although some road include all the throat stays. (2) In the back head at the two outermost rows on the sides and around the top of the door sheet. (3) In the side sheets at (*a*) the two front vertical rows up to the expansion stays, (*b*) the two back vertical rows up to the radial staybolts, (*c*) the two top longitudinal rows of water-space staybolts, and (*d*) the staybolts in the upper front and rear inner corners formed by the staybolts covered in items *a*, *b*, and *c*.

Increases in Boiler Capacity Effected by Feedwater Heater

Q.—How is the increase in boiler capacity due to the use of a feedwater heater determined?—R. J. F.

A.—The boiler capacity is increased by the use of a feedwater heater due to the increase in the temperature of the water being delivered into the boiler, thus requiring less heat to change the water to steam.

The following calculations show the increase in evaporation due to the use of a feedwater heater and are based on test data obtained during maximum operation of the boiler. Given: boiler pressure = 200 lb. per sq. in.; temperature of feedwater = 60 deg. F.; temperature of feedwater delivered by feedwater heater = 230 deg. F.; evaporation of boiler without feedwater heater = 39,600 lb. per hr.

Referring to standard steam tables we find that the heat in one pound of steam at 200 lb. per sq. in. gage = 1,199 B. t. u., and the heat in one pound of feedwater at 60 deg. F. = 28 B. t. u.; therefore, the heat required to raise one pound of water at 60 deg. F. to one pound of steam at 200 lb. per sq. in. gage = 1,199 — 28 = 1,171 B. t. u. The heat in one pound of feedwater at 230 deg. F. = 198 B. t. u.; therefore, the heat required to raise one pound of water at 230 deg. F. to one pound of steam at 200 lb. per sq. in. gage = 1,199 — 198 = 1,001 B. t. u.

The heat required to evaporate 39,600 lb. of water per hr. from 60 deg. F. to steam at 200 lb. per sq. in. gage = 39,600 × 1,171 = 46,371,600 B. t. u. The water that could be evaporated to steam at 200 lb. per sq. in. gage by this amount of heat, if the feedwater was

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at 230 deg. F., would be 46,371,600 / 1,001 = 46,325 lb.

Assuming that the feedwater pump requires two per cent of the steam consumption we have 46,325 × 0.02 = 926 lb. of steam per hr. to operate the pump. Thus, 46,325 — 926 = 45,400 lb. of steam per hr. net evaporation with the feedwater heater, or 45,400 — 39,600 = 5,800 lb. per hr. additional evaporation due to use of the feedwater heater.

Why Welded Plates Buckle

Q.—In butt welding 1/16-in. to 3/16-in. plates in tank and cab work, considerable difficulty has been experienced with plates buckling. What causes this condition and how can this condition be overcome?—F. L. M.

A.—The buckling or warping is due largely to the fact that steel expands when heated and contracts when cooled. The amount of contraction or expansion depends upon the temperature change and the areas involved.

When butt welding, certain physical changes take place. As the molten metal from the welding wire is deposited at the seam, the plate adjacent is heated and tries to expand but is more or less restrained by the colder metal farther away from the seam. The plate near the weld will be heated sufficiently so that it will be forced to undergo plastic deformation, and upon cooling will attempt to assume a shape different than before welding.

The plate adjacent to the weld first expands and then contracts. Therefore, it can be said that as the welding proceeds there is a zone around the arc in which the metal is in the process of cooling and contracting. The weld metal is a part of this latter contracting zone. The net result is that the plates are stressed to a certain degree causing buckling or warping.

To overcome this difficulty the welding procedure must be such that there are no excessive localized stresses during the welding; this is generally accomplished by using what is termed "Skip welding." This method consists in keeping the expanding zones sufficiently narrow and sufficiently close to the contracting zones so that they tend to stress relieve or neutralize each other. This can be accomplished by making a short weld, then skipping some distance ahead, making another short weld, etc., and then returning to the first weld and making another weld adjacent to it, etc. Sufficient time should elapse between making adjacent welds so that the first weld is sufficiently cool and is completely contracted.

Clamping the work is another simple method of reducing warping. This is more effective when the welded members are allowed to cool in the clamps.

Welded Front Tube Sheets

Q.—Would it be permissible to weld the front tube sheet to the shell of a locomotive boiler?—J. S.

A.—The question does not state the type of construction used. If it were the intent to take a typical flanged-type front tube sheet and weld it to the shell around the edges omitting the rivets, it would not be permissible as the strength of the structure would be dependent upon the strength of the weld.

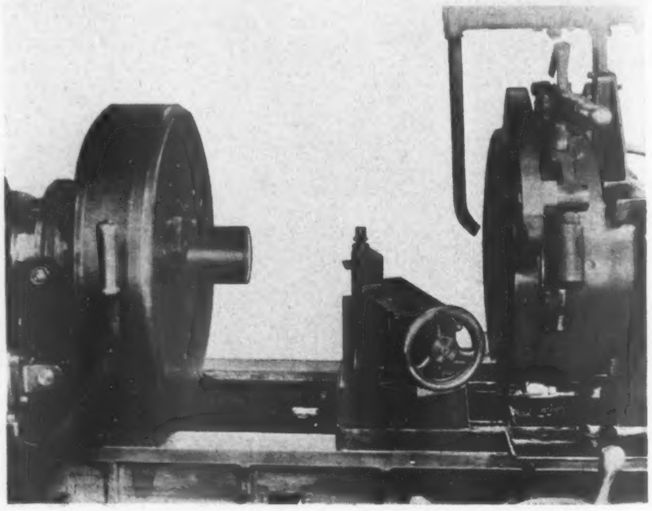
Front tube sheets are being welded on some roads in the following manner: A ring-shaped band is riveted to the inside of the shell and a flat tube sheet is set in behind it; the tube sheet is then welded to the band on the smokebox side, thus eliminating any welding to the shell itself. The weld does not have to hold the pressure, the band taking the load, but simply serves as a seal; thus, the strength of the structure is not dependent on the strength of the weld.

At least one all-welded boiler has been constructed. In this boiler the front tube sheets were held by welded construction. The boiler, however, was constructed as an experiment and special permission was obtained from the Bureau of Locomotive Inspection for its construction.

Tool for Beveling Pipe

The Landis Machine Company, Waynesboro, Pa., recently modified the construction of its line of pipe-threading and cutting-off machines by including a beveling unit on the carriage immediately in front of the threading head. This change was made in order to insure a more accurately formed beveled surface suitable for high-pressure pipe installations using flange joints having gaskets which seat against the beveled ends of the pipe. Although used on all new machines, this beveling tool can be applied to the older models of Landis pipe threading and cutting machines.

In prior constructions the beveling unit was placed back of the threading head, and the pipe overhung a considerable distance beyond the chuck jaws while the beveling operation was being performed. This overhang can



Landis pipe-threading and cutting-off machine equipped with a beveling unit

be materially reduced by the use of a pipe support; however, since the pipe may be somewhat out-of-round, the finished bevel is often unsuitable for application when it is utilized as a sealing surface. With the present arrangement, the pipe end overhangs the chuck jaws a relatively short distance, and its rigidity makes it possible to produce a smoothly finished bevel; where a thread is used in connection with the beveled surface, the bevel is formed absolutely concentric with the thread.

The beveling assembly is pivoted on a base which has been cast integral with the forward projection of the die-head carriage. This base has a graduated scale to show the inclination of the tool assembly with respect to the center line of the pipe. The tool-holder slide has a dove-tailed slot to engage the corresponding dovetail of the base member. A gib is provided so that the clearance between the dovetail and its slot can always be maintained at any desired value. Thrust collars are used on the feed-screw shaft to minimize wear between the shaft and the tool-holder slide.

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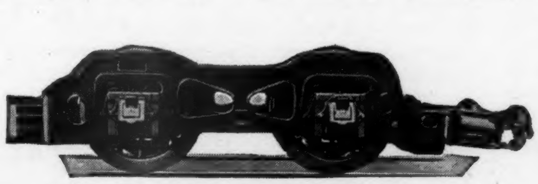

High Spots in

Railway Affairs . . .

Lea on the Job In the House

If Chairman Lea of the House Committee on Interstate and Foreign Commerce has his way, something will surely be done by the present Congress to help the railroads out of their difficulties. Hearings continue to be held on the so-called Lea omnibus transportation bill. Many interests are anxious to present their points of view on various phases of the problem, but the chairman on February 16 asked witnesses to make their statements more brief, else it will not be possible to enact legislation at the present session. Congress is apparently looking forward to earlier adjournment than usual. Fortunately the railroad problem appears to be slated as one of the few "must" items at this session of Congress, the Administration recognizing the importance of railroad prosperity as a vital factor in national recovery. Under these circumstances we may really get somewhere.

Amlie's Nomination May Be Withdrawn

One news commentator—we don't recall his name—suggested that the President was not overfond of the Interstate Commerce Commission and so took occasion, when new appointments were to be made, to select men whose presence on the Commission might prove embarrassing to the other members. If that is true, then the President surely made a good guess in nominating Thomas R. Amlie to succeed Balthasar H. Meyer. It is doubtful if any nominee for appointment to the Commission has ever been so widely and scathingly discussed in the press. A subcommittee of the Senate Committee on Interstate Commerce has held hearings on Amlie's nomination, and there is a rumor as this is written that an effort will be made to induce the President to withdraw the nomination. In any event, it is extremely doubtful if the Senate will confirm the nomination of a man who has been subject to such general and harsh criticism. Mr. Amlie, a former congressman, was defeated last year for senatorial nomination on the Progressive Party ticket of Wisconsin. In a hearing he denied being a Communist and said he held the same views on government ownership of railways as does Commissioner Eastman.

Wheeler Fiddles On

Congress and the Administration are faced with a grave responsibility to the public for the successful operation of the railroads which form the backbone of the American transportation system. Efficient and low-cost transportation is fundamental to the development and prosperity of the nation. Real statesmanship is required and prompt action is necessary—indeed, the task should have been squarely faced up to and completed years ago. Undoubtedly there have been, and quite probably still are, some shortcomings and abuses in the financial operation of the railways. That, however, is true to a like extent in other industries and businesses and in the government itself. Go ahead, Senator, and continue to study and correct these abuses wherever possible, but there will not be much left to deal with, unless constructive and positive action is quickly taken to free the railroads from some of the unfair hardships under which they are now forced to operate. It is high time that the Senate Interstate Commerce Committee did something besides grind out a series of reports of one of its subcommittees, which has been making a study of railroad holding companies, and yet that is about all that it did in the second month of the present Congress, except for the bill introduced by Senator Wheeler to amend the Interstate Commerce Act, by giving the Commission broad powers to regulate the spending of railroad funds for the purchase of other railroad companies.

Commissioner McManamy May Be Replaced

Much to the surprise of railroaders, the President finally decided not to let Commissioner Frank McManamy carry on as a member of the Interstate Commerce Commission until his seventieth birthday, September 3, 1940, and so sent to the Senate the nomination of J. Haden Alldredge to succeed him. Apparently railroad labor leaders were led to believe that Commissioner McManamy would not be disturbed until he reached the age of seventy and also that they would be consulted as to his successor. Mr. McManamy is said to have commented thus: "If we are going to encourage career men, why throw them out when they approach the retirement age? If we are going to have promotions through the civil service, why throw people out when they reach the top?" Mr. Alldredge, a commerce attorney and transportation specialist, is an Alabamian. He has had service in industrial traffic work; was secretary and traffic manager of the Chamber of Commerce, Dothan, Ala.; was admitted to the bar and has practiced before the Interstate Commerce Commission; was chief of the Transportation Bureau of the Alabama Public Service Commission, and more recently was a director of T. V. A.'s commerce department. This department, as characterized by a T. V. A. press release, is "one of the departments created during the recent reorganization of the Authority—another step in the development of a navigation channel in the Tennessee river for commercial use." Railroad labor does not take kindly to Commissioner McManamy's removal and it may be difficult to secure Senate confirmation of Mr. Alldredge's nomination.

Juniors Raise a Howl

Junior, or furloughed train and engine service employees to the number of eighteen, appeared at a hearing held by the House Committee on Interstate and Foreign Commerce on February 16. Their spokesman was Ernest A. Ledwith of Emporia, Kan., a Santa Fe engineer and a member of the Brotherhood of Locomotive Firemen and Enginemen. He pointed out that the federal wages and hours law calls for a maximum week of 44 hours. Many of the "old heads" in train and engine service, however, work from "38 to 60 days per month." If a 26-day maximum month was made effective in railroad service it would put back to work one third of the employees who are now furloughed, said Mr. Ledwith. "Transportation employees of the United States have been graciously and liberally rewarded by dear old Uncle Sam," he said, "and yet their gratitude is shown by the most selfish and hard-hearted methods, the exercise of unbridled seniority. Their attitude is very blunt—they decree the junior man has no right to honest labor until their gluttonous desires, that have taken on the form of insanity, are appeased."

Railway Express Agency Observes Centenary

Early in 1839 William F. Harnden, a ticket agent and conductor of the Boston & Worcester, devised a plan for carrying small parcels, money and valuable papers from place to place on a for-hire basis. It is a far jump from one man with a carpetbag suitcase in 1839 to the Railway Express Agency of today, with its 70,000 employees, doing a business throughout our own country and in many foreign lands. On March 1, 1929, the Railway Express Agency became the property of the railways. Its capital stock is owned by 70 roads, over the lines of which more than 98 per cent of the express business is handled. In 1937 it carried 140,000,000 revenue shipments, many of which consisted of two or more pieces. This required the maintenance of 23,000 offices. More than 11,000 motor vehicles are required for local pick-up and delivery, inter-city transfer between railway stations and over-the-road hauls of shipments in certain cases.

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Among the Clubs and Associations

Northwest Car Men's Association.—"Lubrication" was the subject discussed by L. T. Evans, manager of the Hoosier Waste Renovating Company, at the March 6 meeting.

Toronto Railway Club.—Ladies Night, concert and dancing, also bridge and buffet supper, will feature the meeting to be held at 8:30 p. m. on March 27 at the Royal York Hotel, Toronto, Ont.

Car Men's Association of Chicago.—The Griffin Wheel Company's sound picture and slides on the chilled-iron car wheel will be presented at the meeting to be held at 8 p. m. on March 13 at the La Salle Hotel, Chicago.

Canadian Railway Club.—"Steam Locomotive Slipping Tests" will be discussed by T. V. Buckwalter, vice-president, Timken Roller Bearing Co., at the meeting to be held on March 20 at 8:15 p. m. at the Windsor Hotel, Montreal, Que.

Car Department Association of St. Louis.—A paper on The Car Inspector will be presented at the meeting to be held at 8 p. m., on March 21 at the Hotel Mayfair, St. Louis, Mo. Dinner will precede the meeting at 6:15 p. m.

Indianapolis Car Inspection Association.—F. H. Hardin, president, Association of Manufacturers of Chilled Car Wheels, discussed wheel defects and presented the sound motion picture, "How Wheels Are Made," at the March 6 meeting.

Mechanical Division, A. A. R.—The annual meeting of the Mechanical Division of the Association of American Railroads will be held in New York, June 28, 29 and 30. Sessions will be held in the East Ball Room of the Commodore Hotel, convention headquarters.

New England Railroad Club.—The fifty-sixth annual meeting will be held at 6:30 p. m. on March 14 at the Hotel Touraine, Boston, Mass. Officers for the coming year will be elected, and a motion picture of the United States Steel Corporation "Steel—Man's Servant," will be presented.

Central Railway Club of Buffalo.—The Chilled Car Wheel was discussed by John Matthes, chief car inspector, Wabash; W. R. McMunn, superintendent rolling stock, Merchants Despatch Transportation Corporation, and A. J. Krueger, superintendent car department, New York, Chicago & St. Louis, at the March 9 meeting. The sound motion picture, "The Story of the Chilled Car Wheel," was also presented.

Eastern Car Foreman's Association.—"Loading Rules" is the subject for discussion at the meeting at 8 p. m., on March 10 at the Engineering Societies Building, 29 West Thirty-ninth street, New York. The speaker will be H. L. Phyfe, Freight Container Bureau, Association of American Railroads. Motion pictures of impact tests made by the Freight Container Bureau will be presented. These show, graphically, methods of loading and how loads shift in cars.

DIRECTORY

The following list gives names of secretaries, dates of next regular meetings, and places of meetings of mechanical associations and railroad clubs:

Air-Brake Association.—R. P. Ives, Westinghouse Air Brake Company, 3400 Empire State building, New York.

Allied Railway Supply Association.—J. F. Gettrust, P. O. Box 5522, Chicago.

American Railway Tool Foremen's Association.—G. G. Macina, 11402 Calumet avenue, Chicago.

American Society of Mechanical Engineers.—C. E. Davies, 29 West Thirty-ninth street, New York.
Railroad Division.—Marion B. Richardson, P. O. Box 205, Livingston, N. J.
Machine Shop Practice Division.—Erik Aberg, editor, Machinery, 148 Lafayette St., New York.
Materials Handling Division.—F. J. Shepard, Jr., Lewis-Shepard Co., Watertown Station, Boston, Mass.
Oil and Gas Power Division.—M. J. Reed, 2 West Forty-fifth street, New York.
Fuels Division.—A. R. Mumford, Consolidated Edison Co., 4 Irving Place, New York.

Association of American Railroads.—J. M. Symes, vice-president operations and maintenance department, Transportation Building, Washington, D. C.
Operating Section.—J. C. Caviston, 30 Vesey street, New York.
Mechanical Division.—V. R. Hawthorne, 59 East Van Buren street, Chicago. Annual meeting June 28, 29 and 30, at the Commodore Hotel, New York.
Purchases and Stores Division.—W. J. Farrell, 30 Vesey street, New York.
Motor Transport Division.—George M. Campbell, Transportation Building, Washington, D. C.

Canadian Railway Club.—C. R. Crook, 4468 Oxford avenue, Montreal, Que. Regular meetings, second Monday of each month, except June, July and August, at Windsor Hotel, Montreal, Que.

Car Department Association of St. Louis.—J. J. Sheehan, 1101 Missouri Pacific Bldg., St. Louis, Mo. Regular monthly meetings third Tuesday of each month, except June, July and August, Hotel Mayfair, St. Louis, Mo.

Car Department Officers' Association.—Frank Kartheiser, chief clerk, Mechanical Dept., C. B. & Q., Chicago.

Car Foremen's Association of Chicago.—G. K. Oliver, 2514 West Fifty-fifth street, Chicago. Regular meetings, second Monday in each month, except June, July and August, La Salle Hotel, Chicago.

Car Foremen's Association of Omaha, Council Bluffs and South Omaha Interchange.—H. E. Moran, Chicago Great Western, Council Bluffs, Ia. Regular meetings, second Thursday of each month at 1:15 p. m.

Central Railway Club of Buffalo.—Mrs. M. D. Reed, Room 1817, Hotel Statler, Buffalo, N. Y. Regular meetings, second Thursday each month, except June, July and August, at Hotel Statler, Buffalo.

Eastern Car Foremen's Association.—Roy MacLeod, Room 127, G. O. Bldg., N. Y., N. H. & H., New Haven, Conn. Regular meetings, second Friday of each month, except May, June, July, August and September.

Indianapolis Car Inspection Association.—R. A. Singleton, 822 Big Four Building, Indianapolis, Ind. Regular meetings, first Monday of each month, except July, August and September, at Hotel Severin, Indianapolis, at 7 p. m.

International Railway Fuel Association.—See Railway Fuel and Traveling Engineers' Association.

International Railway General Foremen's Association.—F. T. James, general foreman, D. L. & W., Kingsland, N. J.

International Railway Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark avenue, Detroit, Mich.

Master Boiler Makers' Association.—A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meetings, second Tuesday in each month, except June, July, August and September, at Hotel Touraine, Boston.

New York Railroad Club.—D. W. Pye, Room 527, 30 Church street, New York. Meetings, third Friday in each month, except June, July, August, September, at 29 West Thirty-ninth street, New York.

Northwest Car Men's Association.—E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meetings, first Monday each month, except June, July and August, at Midway Club rooms, University and Prior avenue, St. Paul.

Pacific Railway Club.—William S. Wollner, P. O. Box 3275, San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Calif., alternately, excepting June in Los Angeles and October in Sacramento.

Railway Club of Greenville.—Sterle H. Nottingham, Greenville, Pa. Regular meetings, third Thursday in month, except June, July and August.

Railway Club of Pittsburgh.—J. D. Conway, 1941 Oliver Building, Pittsburgh, Pa. Regular meetings, fourth Thursday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh, Pa.

Railway Fire Protection Association.—P. A. Bissell, 40 Broad street, Boston, Mass.

Railway Fuel and Traveling Engineers' Association.—T. Duff Smith, 1255 Old Colony building, Chicago.

Railway Supply Manufacturers' Association.—J. D. Conway, 1941 Oliver Building, Pittsburgh, Pa. Meets with Mechanical Division and Purchases and Stores Division, Association of American Railroads.

Southern and Southwestern Railway Club.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings, third Thursday in January, March, May, July and September. Annual meeting, third Thursday in November, Ansley Hotel, Atlanta, Ga.

Toronto Railway Club.—D. M. George, Box 8, Terminal A, Toronto, Ont. Meetings, fourth Monday of each month, except June, July and August, at Royal York Hotel, Toronto, Ont.

Traveling Engineers' Association.—See Railway Fuel and Traveling Engineers' Association.

Western Railway Club.—W. L. Fox, executive secretary, Room 822, 310 South Michigan avenue, Chicago. Regular meetings, third Monday in each month, except June, July, August and September.

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A minimum of structural change was involved in the stream-styling of the locomotive which hauls the "Asa Packer," the reconditioned train of the Lehigh Valley operating between Newark, N. J., and Mauch Chunk, Pa. The yellow-and-black finish of the cars is repeated on the locomotive

NEWS

Why Not Stop the Trains at the Crossings

A BILL which would require attachment of "adequate" reflectors to each side of freight cars and unlighted passenger cars on steam railroads, which would be visible for 200 ft. to motorists approaching railroad crossings on unlighted highways, has been introduced into the New York State Assembly by J. H. Chase of Aurora, N. Y., and referred to the State Public Service Commission.

La Locomotive a Vapeur—A Correction

AN error in transcription has been found in Part II of the review of André Chapelon's book in the January issue of the *Railway Mechanical Engineer*. The third conclusion in the first sentence of the third paragraph on page 4 reads: "the saving in heat is greater than the saving in water, and the saving in coal is greater than the saving in heat." This should read: "the saving in coal is greater than the saving in water, and the saving in water is greater than the saving in heat."

Survey Shows 56,311 Miles of Runs Better Than 60 m.p.h.

PUBLISHED timetables of railroads in Canada and the United States at the end of 1938 listed a total of 924 separate passenger runs involving 56,311 route-miles scheduled at an average start-to-stop speed of a-mile-a-minute or better, according to tables compiled by Donald M. Steffee published in the February issue of "Railroad Magazine," of New York. Of these, 864 runs, totaling 47,087 route-miles, are covered daily, while the remainder are covered on a weekly or several-days-a-week basis. This record compared with that publicized by the same magazine eleven months previously in March, 1938, which showed 781 runs aggregating 46,242 miles, of which 38,532 were covered daily.

Reed and Cook Confirmed

THE Senate on January 28 confirmed President Roosevelt's appointments of Mr. Roland Reed to the Railroad Retirement Board and George A. Cook to the National Mediation Board. The five-year term of the former, who succeeded James A. Dailey as the Retirement Board's "railroad" member, will expire August 29, 1943. Mr. Cook, a former secretary of the Mediation Board who succeeded to the membership of the late James W. Carmalt, will serve a term expiring February 1, 1942.

Equipment Repairs and Improvements

The Pennsylvania will recondition and streamline 100 of its passenger cars at its Altoona, Pa., shops.

The Canadian National is continuing its program of modernization and improvement of passenger equipment which has been carried on during the past few years. Work has been started to air-condition 76 additional cars in shops of the company, as follows: 20 coaches at Moncton, N. B.; 8 parlor cars, 2 compartment-observation-buffet cars, 3 diners at the Point St. Charles, Que., shops; 15 coaches at London, Ont.; and 28 sleeping cars at Winnipeg, Man. All principal trains of the National System are now completely air-conditioned, and the present program will enable the use of air-conditioned equipment on a number of trains of lesser importance.

The Western Pacific has spent more than $36,000,000 in an improvement program initiated in 1927. By the end of 1931, when the program was interrupted by the depression, $21,000,000 had been spent for the construction of new lines, new equipment and general improvements to roadway and rolling stock, and this figure was increased $15,250,000 in the last three years by additional expenditures of approximately $12,000,000 for road and equipment, and $3,250,000 for the purchase of locomotives and cars. During the last three years, the improvements have included the construction of a locomotive repair shop at Sacramento, Cal., at a cost of $500,000 in 1938; the purchase of eleven articulated freight locomotives and ten mountain type locomotives in 1938, and the purchase of 200 hopper cars, 200 steel box cars, 50 flat cars and a 200-ton capacity wrecking crane.

The Delaware, Lackawanna & Western will rebuild and remodel 10 steel coaches formerly used in suburban train service. The coaches will be equipped with vestibules, for use in through trains over the main lines. A dining car and a buffet-club car also will be rebuilt and redecorated throughout, including the installation of air-conditioning equipment in the company's shops at Kingsland, N. J. It is expected that the cars will be ready to handle World's Fair traffic.

The Illinois Central during 1939 will build in its shops at Milwaukee, 1,000 50-ton all-steel box cars and 75 steel caboose cars. Six Diesel-electric switching locomotives costing in excess of $400,000 will be acquired under a lease purchase plan. No new passenger cars will be built, but a number of existing cars will be remodeled and air conditioned. Changes will also be made in the road's wheel foundry at Milwaukee, Wis.

British Train to Run 3,121 Miles

A NEW "Coronation Scot," latest streamliner of the London Midland & Scottish, recently arrived in Baltimore, Md., aboard the special railway-equipment-carrier "Belpamela" and is being prepared for a 3,121-mile tour through the eastern United States before being exhibited at the New York World's Fair.

The cars of the "Coronation Scot" which will make the tour comprise one of three completely new train sets recently constructed by the L. M. S. They differ from the original "Coronation" equipment placed in service in 1937 principally in the introduction of articulation and the use of lightweight high-tensile steel. Also, the color scheme is that of the standard L. M. S. lake with gold lining, as contrasted with the blue and silver coronation colors of the "Coronation Scots" now in regular service.

The tour "Scot" equipment consists of eight cars, one of which is a first-class sleeper, as compared with a consist of nine cars in the regular day service trains. The sleeper has been added to the normal consist to show the American public the latest type of accommodations on British night trains. The cars to be on exhibition, in order from the locomotive, are (1) corridor first-class coach with baggage facilities, (2) corridor first-class coach, (3) corridor first-class lounge car with bar, (4) first-class diner, (5) kitchen car, (6) third-class diner; (7) first-class sleeping car; and (8) club-salon car. The tour train has a seating capacity of 173 and weighs 586,880 lb. without locomotive.

The locomotive which will haul the exhibition is "Coronation" No. 6220, one of five identical streamlined "Pacific"-type engines built by the road for "Coronation Scot" service. Representing practically the limit of power and size possible within the limits of British railway clearances, it weighs 368,260 lb. and has an overall length of 73 ft. 9.75 in. Its drivers are 6 ft. 9 in. in diameter, and at 85 per cent of its 250 lb. per sq. in. boiler pressure it exerts 40,000 lb. tractive force. The six-wheel tender carries 4,000 gal. of water and 22,400 lb. of coal and is fitted with a steam-operated coal pusher. In regular service the locomotive picks up water at speed from 11 track pans between London and Glasgow, but for the American tour has been specially fitted to take water from standard water columns. An American headlight and bell have also been added for the tour.

Equipment Installed in 1938

CLASS I railroads of the United States in 1938 installed 18,517 new freight cars in service, according to complete reports for the year made public on January 23 by the Association of American Railroads. This was a decrease of 56,541 compared with the number of such installations in 1937 and a decrease of 25,424 compared with 1936. Class I roads also put in service in 1938 164 new steam locomotives and 118 Diesel-electric locomotives.

The 1938 installations of new freight cars included: coal, 5,195; box, including both plain and automobile, 10,530; refrigerator, 43; flat, 1,529; stock, 496; and miscellaneous, 724.

New freight cars on order on January 1, this year, totaled 5,080 compared with 7,947 on January 1, 1938. New steam locomotives on order on January 1, totaled 30 compared with 131 on January 1, 1938. New electric and Diesel-electric locomotives on order at the beginning of this year totaled 41 contrasted with 30 at the beginning of 1938.

New freight cars and locomotives leased or otherwise acquired are not included in the above figures.

Rehabilitation Will Require Expenditure of $2,000,000,000

THE expenditure of approximately $2,000,000,000 is necessary to replace and repair the railroads' equipment and bring the number of units up to the total of 1926, according to a statement made by Walter M. W. Splawn, member of the Interstate Commerce Commission, in an address before the Bankers Club of Chicago on January 31. "The rehabilitation of way and equipment," he said "is more needed by some companies than by others. A large percentage of locomotives, passenger cars, and freight cars are in need of repair, modernization, or replacement. It is estimated that it will cost nearly $2,000,000,000 to accomplish this end and bring the number of units up to 1926. If this were done, it is estimated that it would increase the capacity of the railroads 40 per cent above 1937 and 13 per cent above 1929. Obviously, this entire expenditure is not justified by the traffic now available. But, going from one company to another, one will find varying degrees of justification for such expenditures. Some companies can make such a good showing that they can repay loans for such a purpose."

10,977 Air-Conditioned Cars

CLASS I railroads and the Pullman Company had 10,977 air-conditioned passenger cars in operation on January 1, according to reports made public February 20 by the Association of American Railroads. This was an increase of 652 compare with the number of air-conditioned passenger cars on January 1, 1938. Of the total number of such cars, Class I railroads on January 1 this year had 6,022, an increase of 458 compared with the same date last year. The Pullman Company on January 1 this year had 4,955 air-conditioned passenger cars in operation which was an increase of 194 compared with January 1, 1938.

C. & E. I. Dedicates New Shops

DEDICATION ceremonies marking the opening of the new coach shops of the Chicago & Eastern Illinois at Danville, Ill., were held on February 2. The new coach shops, which replace those destroyed by fire last year, are 417 ft. long and 110 ft. wide. The building houses a coach paint shop served by four tracks and a coach repair shop with six tracks. Between these are located shops for woodworking, up-

(*Continued on second left-hand page*)

New Equipment Orders and Inquiries Announced Since the Closing of the February Issue

Locomotive Orders

Company	No. of Locos.	Type of Loco.	Builder
Ferrocarril de Antioquia (Colombia)	2	2-8-2	Baldwin Loco. Works
Ford Motor Co.	3	1000-hp. Diesel-electric	General Electric Co.
Mexican Gov't Railways	2	500-hp. Oil-electric	General Electric Co.
Southern Pacific	28	4-8-8-2 (oil)	Baldwin Loco. Works
	12	2-8-8-4 (coal)	Lima Loco. Works
Union Pacific	15	4-8-4	American Loco. Co.

Locomotive Inquiries

Company	No. of Locos.	Type of Loco.	Builder
Atchison, Topeka & Santa Fe	30	Diesel-electric	....
C. R. I. & P.	10	20,000-gal. tenders	....

Freight-Car Orders

Road	No. of Cars	Type of Car	Builder
Lehigh & New England	100	Covered hoppers	Bethlehem Steel Co.
Union Pacific	2,000	Box	Company Shops
U. S. Navy Dept.	2	Flat	Magor Car Corp.
	2	Box	Greenville Steel Car Co.

Freight-Car Inquiries

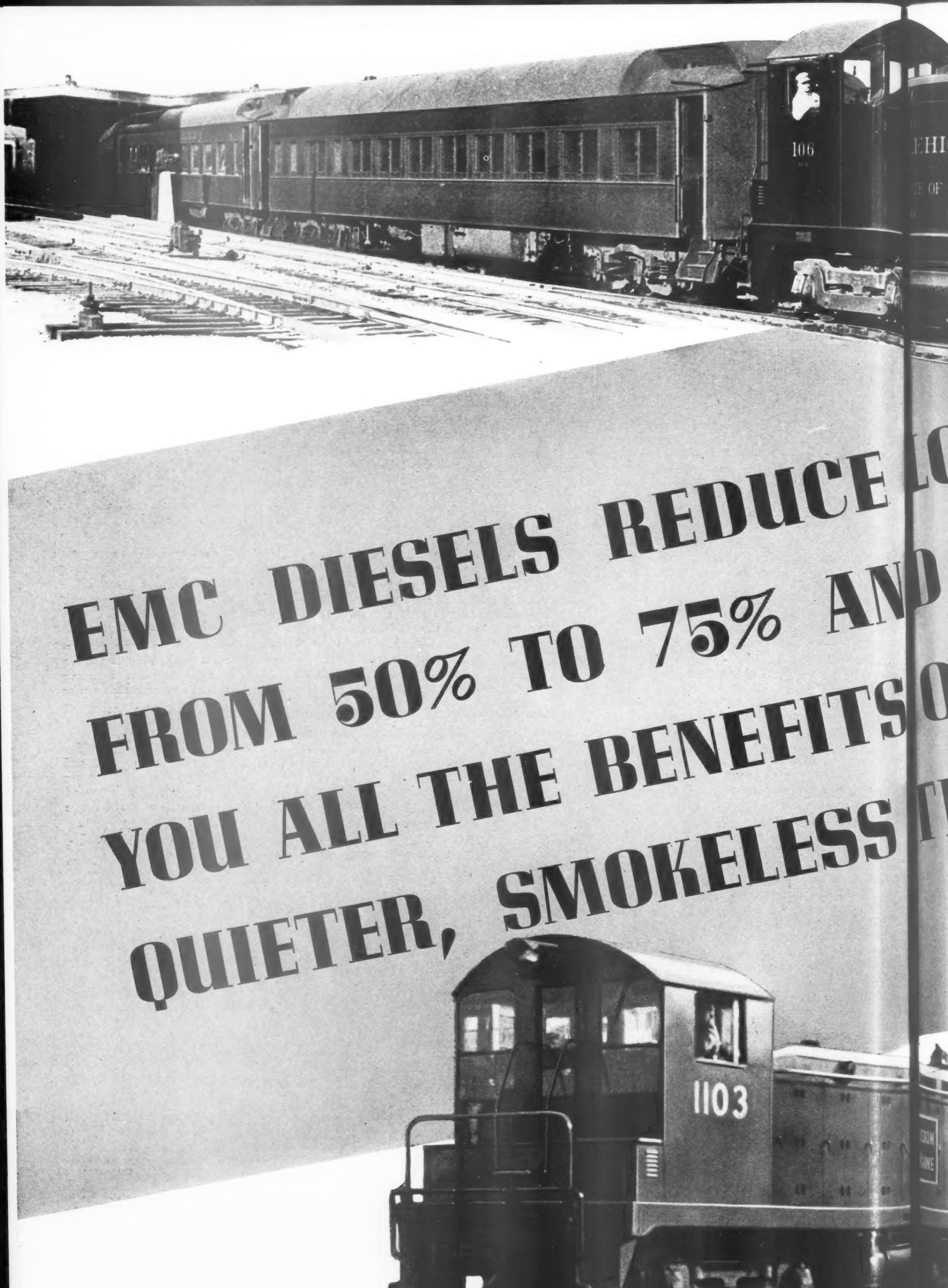
Road	No. of Cars	Type of Car	Builder
C. & N. W.[1]	900	Freight	....
Ill. Central	1,000	Hopper	....
Maine Central	500	40-ton box	....
	150	Twin hopper	....
	100	Gondolas	....
Missouri-Illinois	25	50-ton gondola	....
	125	50-ton box	....
Missouri Pacific	1,000	Gondolas	....

Passenger-Car Inquiries

Road	No. of Cars	Type of Car	Builder
C. R. I. & P.		See footnote 2	....
Delaware & Hudson	6	Light-weight coaches	....
Missouri Pacific	2	Mail-storage	....
	2	Mail-bagg.	....
	2	Coaches	....
	2	De luxe coaches	....
	2	Diner-bagg.-lounge	....
	2	Parlor-observa.	....

[1]Purchase under consideration.

[2]The Rock Island is inquiring for two or seven streamlined trains. Two of the trains, to be used between Chicago and Denver, Colo., will each contain a 2,000 hp. Diesel-electric locomotive, one baggage car, two coaches, one dining car, two sleeping cars and one observation lounge car. These trains, to be known as the Colorado Rockets, will operate on a schedule faster than that of the Rocky Mountain Limited. They will run from Chicago to Limon, Colo., where they will be divided, one train running to Colorado Springs, and the other to Denver.


EMC DIESELS REDUCE
FROM 50% TO 75%
YOU ALL THE BENEFITS
QUIETER, SMOKELESS
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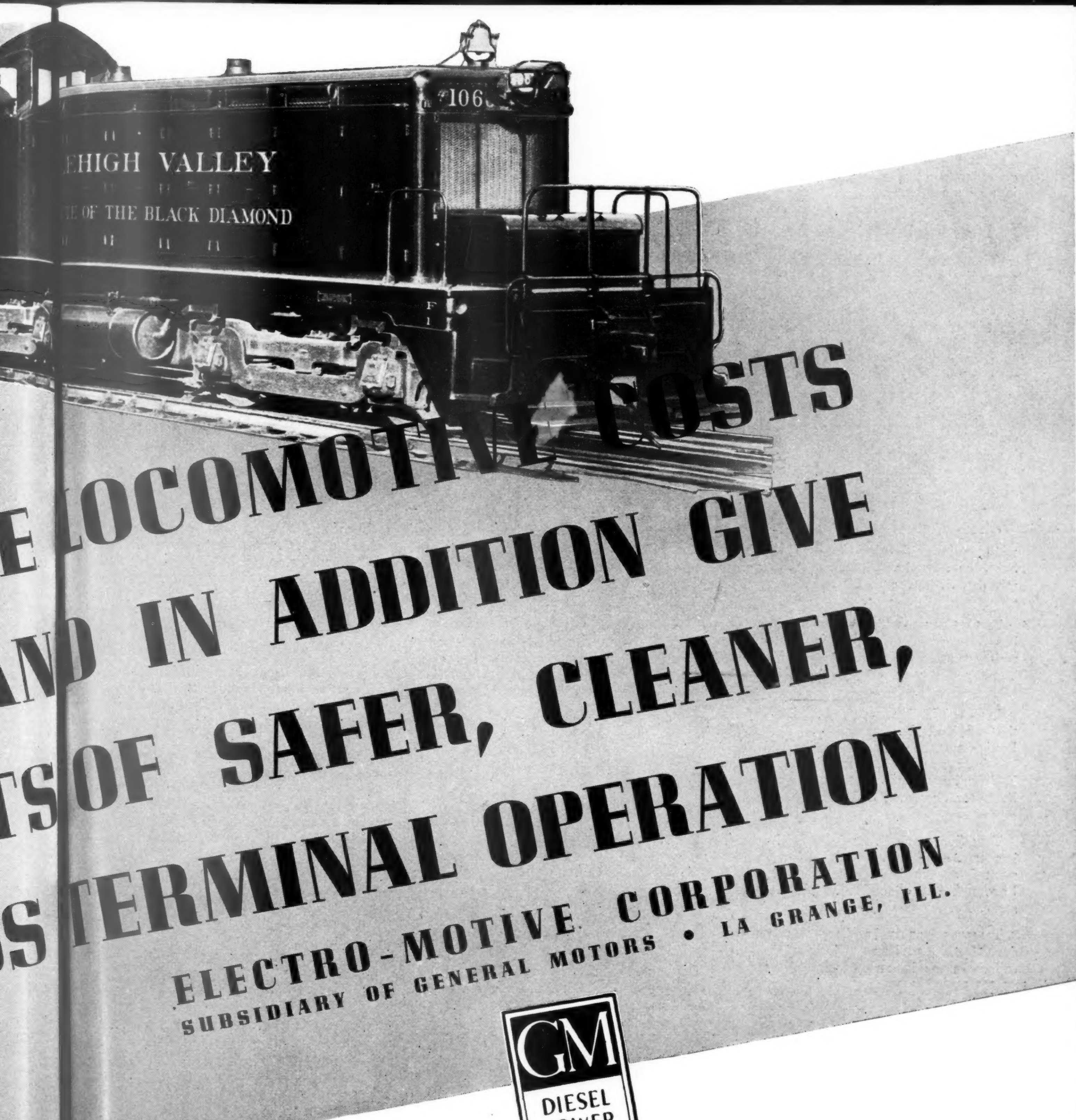

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EHIGH VALLEY
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SUBSIDIARY OF GENERAL MOTORS • LA GRANGE, ILL.
GM
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POWER

holstery, brass, paint and varnish. Adjoining the coach repair shop is a pipe shop, an electrical shop and a battery room. The building is constructed of brick walls on concrete foundations with window openings of glass block.

New Fuel Efficiency Record

A NEW record in fuel efficiency in freight service was established by the railroads of the United States in 1938, according to J. J. Pelley, president of the Association of American Railroads. In that year an average of 115 lb. of fuel was required to haul 1,000 tons of freight and equipment a distance of one mile. This was the best average ever attained by the railroads since the compilation of these reports began in 1918.

The average in 1938 was a reduction of 33.1 per cent compared with 1920, in which year it was 172 lb. It also was a reduction of two pounds compared with 1937 and a reduction of four pounds compared with 1936.

For each pound of fuel consumed in freight service, the railroads in 1938 hauled 8.7 tons of freight and equipment a distance of one mile, which also was the best average that has ever been established. In 1937 the average was 8.6 tons, but in 1920 it was only 5.8.

In the passenger service, the railroads in 1938 used 14.9 lb. of fuel in order to haul a passenger-train car one mile. This was a decrease of one-fifth pound compared with 1937 and a decrease of two-fifths pound compared with 1936. Fuel efficiency in the passenger service, using the same basis of compilation, was nearly 21 per cent better in 1938 than in 1920 when the average was 18.8 lb.

Improvements in the construction of new locomotives, modernization of old locomotives, continued progress in scientific methods of treating boiler water in order to eliminate so far as possible ingredients harmful to locomotives, and improved methods of railroad operation have been among the factors responsible for the almost constant increase in fuel efficiency that has taken place on the railroads of this country in the past twenty years, the statement says.

Supply Trade Notes

LEM ADAMS, chief engineer of the Oxweld Railroad Service Company, Chicago, has been elected vice-president, with headquarters as before in Chicago.

T. C. COLEMAN & SON, Louisville, Ky., has been appointed representative of the railroad sales division of the Cleveland Tractor Company, Cleveland, Ohio.

JAMES W. SEABOUGH, Jr., formery in the mechanical department of the St. Louis-San Francisco, at Springfield, Mo., has been appointed sales engineer of the T-Z Railway Equipment Company and the Brewster Company, Chicago.

THE STANDARD STEEL WORKS COMPANY has transferred its general sales department from Burnham, Pa., to The Baldwin Locomotive Works office building at Eddystone, Pa.

THOMAS DREVER has been elected president of the American Steel Foundries, Chicago. In the February issue of the *Railway Mechanical Engineer* it was incorrectly stated that Mr. Drever had been elected vice-president and treasurer, whereas that is the position he has just vacated.

Thomas Drever

KEITH C. BOWERS of the St. Louis office of Revere Copper and Brass, Incorporated, Chicago, has been appointed sales representative for Western Missouri and Kansas, with headquarters at Kansas City, Mo.

B. C. BROWNING has been appointed national railway representative of Oakite Products, Inc., with headquarters in the Wrigley building, Chicago. Mr. Browning has been associated with the Oakite service organization for the past 10 years. During his first few years he was a representative in Oklahoma territory, concentrating principally on oil refinery and railroad work. Since 1935 his entire time has been devoted to the railway field.

B. C. Browning

J. R. SEXTON, formerly with the Safety Car Heating & Lighting Co., has been appointed sales manager, western division, for The Standard Stoker Company, Inc., with headquarters at Chicago.

THE FLEXROCK COMPANY has moved its general office and plant from 800 North Delaware avenue to larger quarters at Twenty-third and Manning streets, Philadelphia, Pa.

GEORGE W. MORROW, for the past 13 years a sales representative of the Ingersoll-Rand Company, in Chicago, in charge of maintenance of way and bridge and building equipment sales, has been appointed general sales manager of the Reade Manufacturing Co., Inc., Jersey City, N. J.

JOHN F. DEEMS has joined the staff of the Edna Brass Manufacturing Company as vice-president in charge of sales and sales developments. Mr. Deems will have his headquarters in Cincinnati, Ohio, where the general offices and main plant are located. He was born at Tupper Lake, N. Y., and is a graduate of Columbia University. His railroad experience included service in various capacities on the Lehigh Valley, the Baltimore & Ohio, the Delaware & Hudson, and the Delaware, Lackawanna & Western. For the past five years Mr. Deems had been associated with the Union Asbestos & Rubber Co.

J. F. Deems

D. R. ARNOLD has been appointed vice-president of the Standard Railway Equipment Company in charge of sales of eastern and southeastern territories with headquarters at 247 Park Ave., New York. He succeeds Samuel G. Rea, deceased.

J. H. Schroeder, assistant to vice-president, with headquarters at Chicago, has been transferred to New York.

J. T. Whiting, vice-president of the Alan Wood Steel Company, Conshohocken, Pa., has been elected president, and C. E. Davis, assistant to the vice-president, succeeds Mr. Whiting as vice-president. Clement B. Wood, formerly chairman of the board and president, remains as chairman of the board.

John W. Lohnes, for the past three years in the office of the Vanadium Corporation of America, at Chicago, has been appointed assistant to the general manager of sales, with headquarters at 420 Lexington avenue, New York. Prior to his association with the Vanadium Corporation of America, Mr. Lohnes was associated with the Carnegie-Illinois Steel Corporation, at Chicago.

Obituary

Allen E. Ostrander, assistant vice-president of the American Car and Foundry Company, died suddenly at a hotel in New York City on February 5. He was born on June 23, 1877, at New Haven, Conn., and was educated in the New Haven public schools, received private tuition and took courses at Yale University. Mr. Ostrander entered railway service with the New York, New Haven & Hartford, serving successively as messenger, yard clerk, shop apprentice and draftsman. All except the last position were pursued during school vacations. He then served as a draftsman for Cornelius Vanderbilt, detailing patented devices for locomotives and cars. Subsequently, Mr. Ostrander joined

Allen E. Ostrander

the Standard Steel Car Company as draftsman and squad leader. In 1903, as a designer, he entered the employ of the American Car and Foundry Company and served as estimator, later as chief estimator and then as mechanical engineer until 1915, when he was appointed general mechanical engineer. In 1924 he was transferred to the sales department as assistant vice-president. Mr. Ostrander was a member of a number of technical organizations, including the American Society of Mechanical Engineers.

Edward H. Dewson, who was relieved of active duties as district engineer at New York of the Westinghouse Air Brake Company in January, 1922, and since that time served as consulting engineer of the company, died in St. Joseph's Hospital, Tampa, Fla., on February 9, from injuries received a few days previously in an automobile accident.

James F. Cosgrove, for many years manager of service in the railroad division of the Worthington Pump & Machinery Corporation, died on January 21, at his home in East Orange, N. J., after a brief illness. A native of Madison, Wis., Mr. Cosgrove was graduated from the University of Wisconsin with an engineering degree. He afterward joined the faculty of the National School of Electricity in Chicago, and later, for 23 years, was on the faculty of the International Correspondence School at Scranton, Pa., being the author of several textbooks on combustion of coal and the firing of locomotives. He had been associated with the Worthington Pump & Machinery Corporation since 1923.

Personal Mention

General

T. C. Hudson, general superintendent of the Montreal district of the Canadian National at Montreal, Que., has retired. Mr. Hudson was born at Brockville, Ont., and began his railroad career as a call boy with the Canadian Pacific at Carleton Junction in 1886. He served successively as machinist apprentice, machinist, chargehand and erecting-shop foreman, until 1906,

T. C. Hudson

when he was appointed locomotive foreman at Ottawa, Ont. In 1907, he joined the Canadian Northern Ontario as foreman at Parry Sound, Ont., and later in the same year was appointed master mechanic at Shawinigan Falls, Que. In 1908, he was transferred to Quebec and to Joliette, Que., in 1910 in the same capacity. With the formation of the Canadian National Railways in 1918 Mr. Hudson was appointed general master merhanic, Eastern lines, with headquarters at Montreal. When the amalgamation of the Canadian National-Grand Trunk Railways took place in 1923, Mr. Hudson was appointed assistant general superintendent of motive power, Central region, at Toronto. He remained in this position until June. 1929, when he was appointed general superintendent of operation, Southern Ontario district. In June, 1936, he became general superintendent of the Montreal district. During the World War he was in charge of locomotives handling all trains for troop movements to and from Valcartier. Mr. Hudson is a past president of the Canadian Railway Club of Montreal and of the International Fuel Association, Chicago. He also assisted in the formation of the Railway Club in Toronto and was elected its first president in 1931.

Car Department

Orlin H. Clark, supervisor of car repair bills of the Missouri Pacific at Houston, Tex., has been promoted to the position of general car inspector with headquarters at Houston.

U. E. Bernecker has been appointed general car foreman of the Pere Marquette, with headquarters at Flint, Mich., succeeding A. B. Bailey, deceased.

Allen D. Welch has been promoted to the position of car foreman of the shops of the Chesapeake & Ohio at Handley, W. Va.

Shop and Enginehouse

J. Milne, boiler foreman of the Canadian National at Edmonton South, Alta., has retired.

J. Hawthorne, boiler foreman of the Canadian National at Melville, Sask., has been appointed boiler foreman at Edmonton South, Alta.

A. M. Muckle, locomotive foreman of the Canadian National at Portage La Prairie, Man., has been appointed locomotive foreman at Swan River, Man.

P. H. Maley has been appointed general boiler inspector of the Chicago Great Western, with headquarters at Oelwein, Iowa.

H. B. May, locomotive foreman of the Canadian National at Swan River, Man., has been appointed locomotive foreman at Portage La Prairie, Man.

Stephen J. McDonald has been appointed acting day locomotive foreman of the Canadian National at Point Tupper, N.S.